POPULATION STATUS AND TRENDS OF SEA DUCKS IN ALASKA

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EXECUTIVE SUMMARY

Our knowledge of sea duck biology, ecology, and mortality factors is generally meager. However, recent surveys, research and personal observations suggest dramatic declines in several species and populations. Concern about sea duck populations in the Pacific Flyway prompted this report. The objective of this report is to present existing information about sea duck biology, population trends, and harvest for species that occur in Alaska to better assess their status and provide guidance for program planning and management. The compilation is based on a review of literature and results of various surveys. The only long term data set is that of the annual North American Waterfowl Breeding Population Survey (NAWBPS). However, because this survey was designed for species other than sea ducks, geographic coverage is incomplete and survey timing is not optimal for many species of sea ducks. These data should be interpreted with these limitations in mind, and no other reliable long term population indices exist for sea ducks throughout North America. The NAWBPS and other more recent surveys flown in Alaska indicate obvious downward trends for some species or species groups (i.e., eiders, oldsquaw) but trends are unclear for others. Spectacled and Steller's eiders are currently listed as threatened under the Endangered Species Act due to drastic declines in Alaska breeding populations. Long term declines in oldsquaw, and perhaps scoters, seem to be continuing. Alaska breeding populations of other species including goldeneyes, bufflehead, king eider, common eider, and greater scaup apparently declined since the late 1970's but appear stable or have increased over the past 10 years. Merganser populations have consistently increased. Data for harlequin duck are inadequate to determine population status in Alaska. Estimates of subsistence and sport harvest of sea ducks in Alaska are very imprecise but provide some insight into the magnitude, timing, locations, and species composition of harvest. Subsistence harvest accounts for about 90% of statewide total harvest. Expanded research and management efforts are required to better understand the biology of sea ducks and to determine their current status and limiting factors. We present a list of tasks prioritized by the Alaska Sea Duck Working Group intended to improve our understanding of sea duck population ecology and management.

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INTRODUCTION

Sea ducks are a diverse group of waterfowl taxonomically assigned to the tribe Mergini (Humphrey 1958, Johnsgard 1960, Bellrose 1980). Alaska supports breeding populations of 15 waterfowl species classified as sea ducks. The tribe *Mergini* includes four arctic eiders: common eider (*Somateria mollissima)*, king eider (*Somateria spectabilis*), spectacled eider (*Somateria fischeri*) and Steller's eider (*Polysticta stelleri*). Scoters include black scoter (*Melanitta nigra*), white-winged scoter (*Melanitta fusca*), and surf scoter (*Melanitta perscipillata*). Harlequin duck (*Histrionicus histrionicus*) and oldsquaw (*Clangula hyemalis*) are placed in separate genera. The *Bucephala* genus includes Barrow's goldeneye (*Bucephala islandica),*common goldeneye (*Bucephala clangula*), and bufflehead (*Bucephala albeola*). Genetic analyses show *Bucephala* spp. closely related to diving ducks (Patton and Avise 1985) including greater scaup (*Aythya marila*) and lesser scaup (*Aythya affinis*), which, on the basis of biology, distribution and habitat use, are generally considered "sea ducks" and are included in this review. Mergansers include red-breasted (*Mergus serrator*) and common (*Mergus merganser*) merganser.

Sea ducks are important to Alaskan subsistence and sport hunters as well as bird enthusiasts from Alaska and worldwide. Despite liberal bag limits and seasons on most sea ducks, sport harvest in Alaska is low compared to most other northern coastal states. However, sport harvest surveys are not designed to estimate sea duck kill because sea ducks have traditionally been among the least hunted waterfowl. Subsistence harvest of sea ducks has been a tradition of Alaska Natives for thousands of years. Even with the recent protocol amendment to the Migratory Bird Treaty Act, subsistence take is still technically illegal because it occurs outside of developed regulations. The greatest proportion of harvest occurs in the spring as birds return to breeding areas (Wentworth 1998).

Information from a number of sources suggest that some sea duck populations have declined in North America and in Alaska (Kertell 1991, Stehn et al. 1993, Goudie et al. 1994, Hodges et al. 1996). For many species, population trends are not clear but for others, trends are alarmingly obvious. Spectacled and Steller's eiders were listed as threatened species under the Endangered Species Act in 1993 and 1997, respectively. The eastern North American population of harlequin ducks was listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (Montevecchi et al. 1995). Concern for sea ducks on the Atlantic Coast prompted a status report (Sea Duck Committee 1994) which is a precursor for a management plan for sea ducks in the Atlantic Flyway. Issues besides hunting have driven concerns for sea ducks in the Pacific Flyway. Bartonek (1993) noted these concerns: the listing action on spectacled and Steller's eiders; the losses of harlequin ducks stemming from the *Exxon Valdez* oil spill; and dieoffs of scoters in the Gulf of Alaska. Reliable information on population status and trends, production, harvest, mortality and survival is needed. Specific data gaps should be identified and studies prioritized to begin gathering missing information.

The purpose of this document is to provide information on status and population trends for sea ducks that occur in Alaska. It is intended to help focus on key issues and management needs of sea ducks and is a preliminary step to incorporating information from Washington, Oregon and

California and eventually, Canada and Russia. Objectives of this document are to:

A. Present available data on population status and trends for sea ducks found in Alaska;
B. Provide guidance for program planning and budgeting necessary to implement a sea duck management program in Alaska, and to complete operational plans for selected species and species groups; and
C. Promote internal and interagency communication and coordination regarding sea duck management and information needs in Alaska.

Further step-down planning for individual species is needed. Some species plans are already prepared: a Spectacled Eider Recovery Plan has been completed and a Steller's Eider Recovery Plan is being developed by the Fish and Wildlife Service. An Action Plan for the Steller's Eider is in final draft form under the lead of Wetlands International (Pihl 1997). A cooperative research strategy for king and common eiders breeding in northern Canada has been developed (Canadian Wildlife Service 1996). The Circumpolar Seabird Working Group, under the Conservation of Arctic Flora and Fauna (CAFF) initiative, drafted a *Circumpolar Eider Conservation Strategy and Action Plan* which recognized the need for international cooperation.

Species accounts presented here emphasize distribution, biology, status and population trends in Alaska. A large body of literature pertaining to sea duck populations in Canada, Europe and Russia is not addressed in this draft. Some analyses of population and harvest data are preliminary and subject to change. Finally, we present a list of tasks, prioritized by the Alaska Sea Duck Working Group, which are intended to improve our understanding of sea duck population ecology and management.

GENERAL SEA DUCK ECOLOGY

Although waterfowl as a group are one of the most studied groups of birds, relatively little is known about sea ducks. Research and management efforts are challenging due to the remote and inaccessable areas sea ducks inhabit, their long range migrations and intercontinental movements, and logistical complexities and high cost of investigations at high latitudes. As a result, their biology is poorly understood and life history information is incomplete for most species.

Sea ducks nest in wetlands throughout Alaska, including inland lakes and streams as well as coastal areas. The time and season the different species of sea ducks spend at sea varies greatly. While many of them frequent marine areas during winter, they are generally found nesting far from the coast and may even winter in freshwater environments. Nesting habitats include arctic tundra, boreal forest, coastal rain forest and inland mountain regions, depending on the species. Wintering habitats include estuaries and other coastal waters from the Arctic Circle to Mexico, large freshwater lakes or rivers, and open water in the pack ice of northern oceans. A growing body of literature suggests that many species are highly philopatric to breeding, molting, staging, and wintering areas (Erskine 1961, Savard 1985, Gauthier 1990, D. Esler, pers. comm., Flint et al. in press, Anderson et al. 1992, Larned 1998).

Important influences on the life history strategies of northern sea ducks are the extreme environmental conditions in both breeding and non-breeding environments and the high degree of variability both within and among these environments. Biological and climatological phenology of the breeding season varies from year to year in northern regions. Life cycles of northern marine birds (timing of arrival on breeding grounds, reproductive cycle, and migration) are directly affected by seasonal changes in the hydrological and hydro-biological conditions. Timing of snow melt and the break-up of seasonal ice in marine waters along migration routes and in freshwater ponds on breeding grounds can vary by several weeks. This increases the potential for delayed nesting, reduced clutch sizes, and non-breeding (Barry 1960, 1968, Cooch 1965, Ryder 1967, Kistchinski and Flint 1974, Dau 1976, Coulson 1984, Cornish and Dickson 1997).

Sea ducks must be adapted to life at sea and on land, and to both marine and freshwater environments. Different strategies for foraging, locomotion, water balance, and thermoregulation are required in each of these environments. Furthermore, life in northern regions requires specialized adaptations to extreme climatic variability.

Sea duck foraging habits vary among species and seasons. Aquatic vegetation may comprise a moderate to large proportion of the summer diet while benthic crustaceans and mollusks or fish predominate at non-breeding sites. Specialization in diets may restrict distribution of sea ducks. Restricted distributions increases a species susceptibility to local catastrophes when concentrated around food resources, especially in marine habitats. Scoters, which are both specialized and somewhat restricted to nearshore beds of mollusks, have fallen victims to oil slicks and other forms of oil pollution (Smail et al. 1972). Similarly, harlequin ducks suffered significant mortality as a result of the Exxon Valdez oil spill (Patten et al. 1998).

Available information indicates that sea ducks are long-lived, annual adult survival is high (in a healthy population), annual recruitment to breeding age is low, annual breeding rates and success are variable, clutch sizes tend to be small, and sexual maturity is deferred (Goudie et al. 1994). Ecologists refer to species with this reproductive strategy as “K-selected” (Wilson 1980). This strategy minimizes the importance of annual investment in reproduction and maximizes the importance of annual survival with population stability maintained by high adult survival and a few successful years of reproduction.

Primary productivity of wetland habitats at high latitudes can be high because of extensive daylight. Although the phenology of the arctic summer varies from year to year, it is relatively short. Ducklings must be ready to leave the breeding grounds, transition to the marine environment, and undertake migrations by the end of this short season. If nest initiation is late in a given year because of climatic conditions, the likelihood of reproductive success is lowered. Therefore, there is a greater likelihood of failed breeding occurring in any given year as a result of delayed onset of breeding than there would be at more southerly latitudes. A life history strategy that favors adult survival and a longer lifespan (“K-selected”) rather than high productivity and a short lifespan (“r-selected strategy”) may result in greater total lifetime productivity (Goudie et al. 1994).

Management for recovery of declining sea duck populations is difficult because K-selected life history traits may limit the rate of recovery. Population parameters common to K-selected species can not easily be manipulated by traditional management procedures such as habitat modification. Management practices often strive to improve adult survival rather than productivity (e.g., regulation of hunting); this is particularly difficult for species for which mortality sources are poorly understood. Small clutch size, low rates of annual reproduction, and low annual recruitment to a breeding population may result in slow population growth even in the absence of threats.

DATA SOURCES

Table 1 summarizes survey data for several of the following surveys:

North American Waterfowl Breeding Population Survey (NAWBPS)
Several species or species groups of sea ducks have been counted annually in Alaska since 1957 during the NAWBPS conducted from mid-May to early June (Hodges et al. 1996). The purpose of this survey is to provide reliable population indices of most duck species and to monitor population trends in habitats representative of primary North America breeding grounds. The survey areas include most of the major waterfowl breeding habitats with the exceptions of the Arctic Coastal Plain (ACP), for which a separate survey was begun in 1985, and small wetlands from the Aleutian Islands through southeast Alaska. The survey area of the NAWBPS consists of 12 geographical strata (Fig. 1). Four of the strata are in the tundra habitats of western Alaska and encompass 118,820 km^2; seven of the strata are located primarily in boreal (taiga) habitat totaling 88,660 km^2; and the third area is one stratum at Old Crow Flats, 5,122 km^2 of wetland along the Yukon River in the Yukon Territory.

Breeding ranges of eiders, oldsquaw, scoters, scaup, goldeneyes, and mergansers partially contained are within the survey area but population indices for these sea duck species are affected by 2 factors: 1) similar species are lumped (i.e eiders, scoters, scaup, goldeneyes, and mergansers historically were not differentiated to species) and 2) surveys were designed to obtain the best population indices of dabbling ducks and geese and are timed to record peak numbers of dabbling ducks as opposed to sea ducks (Petersen and Hogan 1996). This may be appropriate for sea duck species in coastal areas, but in interior areas such as the Yukon Flats, some scoters and scaup en route to more northerly breeding areas may be present during the survey resulting in inflated indices due to their being counted in more than one survey area. Or, in years when northern and northeastern tundra habitats that are beyond the aerial survey area become available early, the surveyed, more southern, areas may no longer hold any birds and population indices could be biased in the opposite direction. Also, in late years these ducks may not have arrived yet.

The number of ducks were adjusted according to the protocol of the U.S. Fish and Wildlife Service and Canadian Wildlife Service (1987). Lone female ducks were not counted. The number of male ducks unaccompanied by female ducks was doubled to account for the female duck that was not seen but assumed to be present. Male scaups were not doubled because of the propensity for two or more males to accompany one female. If $\geq$5 males were in a group, their numbers were not doubled because it was assumed that each was not attending a breeding female. The population-size estimates of ducks were the products of the numbers of indicated ducks per km^2, the number of km^2, and a visibility correction factor.

The visibility correction factors for Alaska were determined for most species by a helicopter/fixed-wing comparison study conducted in Yukon Flats National Wildlife Refuge and Yukon Delta National Wildlife Refuge for interior and coastal tundra habitats, respectively. For this study scoter, scaup, and mergansers species were grouped. Eiders were not included because helicopter operation was not permitted in the coastal portions of the YKD. For all eiders the standard NAWBPS visibility ratio of 3.58 continues to be used to adjust survey data.

Population trends derived from NAWBPS data for some sea duck species should be interpreted with caution because of inadequate sample sizes, the lumping of 13 species into 5 groups, and because the timing of the survey may precede the influx of an unknown number of breeding birds to some strata. In other strata, the timing of the survey may result in some birds counted while still in migration, thus causing some bias in analyses of distribution, population size, demography and species composition. This is especially true on the Yukon Flats, one of the most important habitats for breeding surf and white-winged scoters (USFWS 1964, Lensink 1965). However, because of the consistent survey effort over 38 consecutive years, the NAWBPS is an important, and often the only, source of trend data for species and species groups surveyed in Alaska (Hodges et al. 1996).

Natural logarithmic curves provided trend lines to the time series data. Three regression lines were fit; one for data from 1957-76, one for 1977-98, and one for the most recent 10 years, 1989-98. The break in 1977 was made due to a change in aircraft type, from piston airplanes to a turbine deHavilland beaver, which afforded better visibility and resulted in an apparent (but artificial and instantaneous) increase in the population-size index for nearly all species (Hodges et al. 1996).

Arctic Coastal Plain (ACP) Breeding Pair Survey

In 1985 an aerial breeding pairs survey was initiated by the U.S. Fish and Wildlife Service (USFWS) on the ACP of Alaska to provide data for the one primary area of waterfowl habitat not included in the NAWBPS. The survey sample includes approximately 2 percent of the 63,200 km^2 of contiguous waterbird habitat north of the Brooks Range, from the northwest coast of Alaska east to the U.S.-Canada border (Brackney and King 1996) (Fig. 2). The survey is conducted from late June to early July, which coincides with the nesting phenology of tundra swans, geese and dabbling ducks. This timing may be appropriate for sea ducks with the exception of eiders because some male eiders depart breeding sites prior to the survey (Warnock and Troy 1992). The survey also fails to cover barrier islands which are the primary nesting areas for common eiders. Bird observations were recorded as singles, pairs, and flocked birds according to the protocol of the USFWS and Canadian Wildlife Service (1987). Except for eiders, data reported for this survey have been adjusted for incomplete detection using the visibility correction ratios developed on the YKD for the NAWBPS.

North Slope Eider Survey (NSE)

In 1992 a survey preceding the ACP pairs survey was initiated by the USFWS to estimate the population size, trend and distribution of breeding spectacled eiders on the North slope. Approximately 4 percent of 39,000 km^2 was surveyed (Fig. 2). Survey initiation dates have varied from 7-20 June and survey completion dates from 17-29 June. The NSE survey follows snow melt as closely as possible and is timed for optimum presence and visibility of spectacled eider males. Spectacled eider and king eider males depart breeding grounds for molting areas by early to mid-incubation (Lamothe 1973, Kistchinski and Flint 1974, Dickson et al. 1997); therefore survey timing is critical (Larned and Balogh 1997). The survey is believed to precede the departure of most males from breeding habitats. Eider data for the 1992 survey was disregarded because timing was considered too late for spectacled and king eiders. Bird observations were recorded as singles, pairs, and flocked birds according to the protocol of the USFWS and Canadian Wildlife Service (1987). The presence of lone or flocked males is believed to indicate females have initiated nesting. Lone and flocked males (≤7 in flock) are doubled and combined with the number of observed pairs to estimate the total number of breeding pairs. Data reported for this survey are not adjusted for incomplete detection because the required visibility studies have not been completed for the survey, and the investigators felt that rates determined elsewhere may not be appropriate for this survey. All species of waterbirds are counted during this survey. Indices for oldsquaw and greater scaup seem adequate to track trends and distribution within the survey area, and these trends closely paralleled those detected during the later ACP Breeding Pair survey, though the latter survey provided more complete geographic coverage. For red-breasted merganser and scoters, results showed small and highly variable indices, suggesting that geographic and temporal coverage were not adequate for those species. The survey provides annual distribution, population estimates and trends however, as with the ACP breeding pairs survey, these should be viewed in light of species breeding phenologies. Common eiders, which prefer to nest on barrier islands outside the survey area, and Steller's eiders, of which <15 individuals are observed each year, are not sampled adequately on the NSE survey.

Yukon-Kuskokwim Delta (YKD) Coastal Zone Survey

In 1985 an aerial survey of approximately 8 percent of 13,500 km^2 of coastal habitats of the YKD was initiated by the USFWS to estimate population sizes and trends in declining goose species (Butler and Malecki 1986) (Fig. 2). This annual survey has undergone revisions and in 1988 was expanded to include sea ducks counted by a right rear seat observer. The survey is timed to coincide with the onset of incubation in geese (usually early June) which, with the exception of black scoter and greater scaup, is appropriate for sea duck species as well. Scoter and scaup, although nesting later, appear to be distributed in breeding territories during the survey suggesting population indices may be accurate. In addition to annual estimates of sea duck population sizes and trends since 1988, this survey has provided indices of breeding distribution and densities. Data reported for this survey are not adjusted for incomplete detection.

Yukon-Kuskokwim Delta Nest Plots

This annual assessment of nest population size and trend, established in 1986 to monitor trends of declining goose species in high density coastal habitats, also provides indices for common and spectacled eiders, which are concentrated in the sampled area (Bowman et al. 1998). Nesting distributions of other sea duck species on the YKD are dispersed and data from this survey are inadequate to document population trends. The boundaries of the sampled area are within areas of medium and high densities of breeding pairs observed during YKD Coastal Zone Surveys (Fig. 2). Up to 75 randomly located 0.32 km^2 plots were searched by 1-4 biologists to determine the number and status of waterfowl nests. Nest estimates for the sampled area are expanded to the entire YKD, based on the proportion of all YKD breeding pair aerial observations in the sampled area. Reported indices of nest abundance have not been adjusted for nest detection rates.

Steller's Eider Spring Migration Survey - Southwest Alaska

This aerial survey was begun in 1992 by the USFWS to develop a technique to monitor pre-breeding populations of Steller's eiders in southwestern Alaska and document distribution and habitat use during spring migration. It has been conducted in 1992, 1993, 1994, 1997, and 1998. The study area included coastal sea duck habitats from Cape Romanzof on the YKD to Bechevin Bay at the tip of the Alaska Peninsula. Essentially, all estuaries, and nearshore waters within 2 km of land and a few areas further offshore were surveyed. The exact flight path was left to the discretion of the survey crew with the objective to count all Steller's eiders. Other species of birds and mammals were also counted. The survey was flown 1-4 times each year; multiple surveys are intended to bracket the spring migration period. The highest replicate total for each year is the estimate of the pre-breeding population of Steller's eiders. Variation between surveys was partially due to frequent changes in right-seat observers, differences in timing relative to spring migration, and variation in visibility rate. In 1998 flock counts from aerial photographs were used to estimate observer estimation bias to improve accuracy of Steller's eider estimates. Investigators intend to continue and expand that effort. Data for other species may be of limited value for estimating population size because of lack of knowledge about timing and patterns of migration, but have been useful in helping to identify important migration habitats, and providing long-term trend information.

Expanded Breeding Population Surveys

These aerial surveys, conducted by the USFWS from 1989 to 1997, were designed to augment the NAWBPS by providing a more detailed picture of the densities and distribution of breeding waterbirds, including sea ducks, within the major breeding habitats in Alaska. Grids of straight-line transects were flown using techniques identical to those of the NAWBPS, but sampling intensity was much higher, averaging about 5 percent, compared with about 1 per cent for the NAWBPS. Timing of surveys was generally a compromise across species, and when interpreting data care should be taken to read remarks pertaining to phenology of the various species. Areas covered included the Yukon Flats (1989-92), west coast (coastal lowlands from Stuart Island to Point Hope, 1992-93), Bristol Bay lowlands (Togiak to Port Heiden, 1993-94), Innoko River flats (1994-95), Selawik National Wildlife Refuge (1996-97), Koyukuk National Wildlife Refuge (1996-97), and Kanuti National Wildlife Refuge (1997).

Spectacled Eider Winter Survey

This aerial survey was initiated to verify the existence, determine the persistence, and quantify a wintering concentration of spectacled eiders in the Bering Sea as indicated by limited satellite telemetry data. The survey was conducted each March, 1995-98, in an area between St Lawrence and St. Matthew Islands. Two observers made visual counts of eiders and photographed flocks in small openings in pack ice. Actual counts of adult-male-plumaged birds were obtained from photos and numbers of female-plumaged birds and thence total birds were estimated by extrapolating from a subsample of high quality photos in which both white males and dark-brown females were detectable. Two surveys were flown in 1998 to evaluate the replicability and precision of the survey. It is generally believed that the vast majority of the worldwide population of spectacled eiders winters in this area. Accurate and complete counts of the population depend largely on such variables as weather, ice distribution, and bird distribution during the survey.

Molting and Staging Area Surveys

Aerial surveys consisting of search grids and shoreline transects were conducted by the USFWS in 1993 and 1994 over 4 potential spectacled eider molting areas and one early winter staging area based on analysis of 2 years of satellite telemetry data. Areas surveyed in Alaska included Ledyard Bay, eastern Norton Sound, Peard Bay, Kuskokwim Bay, and the waters surrounding St. Lawrence Island. Also surveyed was Mechigmenan Bay and other waters off the eastern Chukotsk Peninsula in eastern Russia. Numbers obtained on these surveys roughly estimate the populations using these molting areas at the time the surveys are conducted, and delineate important seasonal habitats.

Southeast Alaska Winter Waterbird Surveys

An aerial survey was used to estimate the numbers of waterbirds present in southeast Alaska during winter. The survey was conducted from 13 Feb to 1 Mar, 1996. A set of 130 stratified random plots was selected from a possible set of 650 plots representing southeast Alaska using a maximum allocation of effort scheme. Each plot was a quarter section of a USGS quadrangle (1:63,360 scale) map. All marine habitat, except that >1 nautical mile off the seaward coast and all unfrozen freshwater, was included in the survey area. Plots were searched 2 ways: shoreline/intertidal areas were surveyed following a track about 0.2 km from the existing waterline at the time of survey; estimates for open water areas were based on either complete counts (where open water areas were small) or transect sampling over large areas. Estimates for shoreline and open-water areas were combined to produce totals for each plot. In addition to plots, 196 major tide flats were preselected and surveyed in entirety. Estimates were adjusted for detection bias using visibility correction factors derived from a comparison of ground counts to air counts in Port Frederick in a 1982-84 study. Scoters, mergansers, scaup, and goldeneyes were not differentiated to species, thus estimates are reported only for species groups for these birds.

Prince William Sound Marine Bird Surveys

These boat-based surveys were designed to monitor marine bird populations of Prince William Sound (Fig. 2), particularly those species thought to be impacted by the *T/V Exxon Valdez* oil spill. Because the survey includes all marine bird species, the study serves to monitor those marine bird populations not initially designated as impacted, including several species of sea ducks.

Surveys were conducted in March of 1990, 1991, 1993, 1994, 1996, and 1998. During March, populations are believed stable and represent wintering birds from unknown breeding areas. Prior to the oil spill, the U. S. Fish and Wildlife Service conducted marine bird surveys in PWS in winter 1972-73 (L. Haddock et al., unpubl. data) using similar methods that enable comparison to recent surveys. Transects were surveyed in 15-17 working days over a 3-week period. Survey methodology and transect locations were identical in all years. Surveys were conducted concurrently by three 7.7 m fiberglass boats traveling at speeds of 10-20 km/hr. Two observers counted all birds and mammals detected in a sampling window 100 m on either side, 100 m ahead, and 100 m overhead of the vessel.

Transects were sampled in 3 strata:shoreline, coastal-pelagic, and pelagic. A ratio estimator was used (Cochran 1977) to estimate population abundances and variances (Klosiewski and Laing 1994).

Lower Cook Inlet Marine Bird Survey

This boat-based winter survey of seabirds was conducted in 1994 to assess potential effects from oil and gas extraction activities in Lower Cook Inlet. Survey methodology was similar to that used in Prince William Sound marine bird surveys. An aerial survey was conducted over most of the survey area for comparison to boat data.

Kodiak Archipelago Steller's Eider Surveys

Coastal aerial surveys were flown in late winter from 1992 to 1994 from Chiniak Bay to Olga Bay to determine abundance and distribution of Steller's eiders in that area. Other waterbirds including sea ducks were counted as well. Data were collected and presented as totals per mapped shoreline segment, referenced by prominent shoreline features.

Waterfowl Production Surveys

These surveys were conducted annually at varying intensity, and often with varying methodology and survey design, from 1983 to 1993. Survey plots were chosen either at random or for ease of access within several production areas that roughly correspond to NAWBPS strata, including: Copper River Delta, Kodiak, the North Slope, the Southcoastal area (mostly Kenai Peninsula), Yakutat, Gulkana, Tanana-Kuskokwim, Yukon Flats, Innoko, Koyukuk/Kanuti, Bristol Bay, YKD, and Seward Peninsula. In 1993, only the North Slope, Seward Peninsula, Kodiak, and Koyukuk production areas were surveyed. Plots were searched by foot and/or by canoe in some areas and by helicopter in others. Broods and number of young were counted and recorded by species, although goldeneyes were not differentiated. These surveys were timed to occur midway between the peak occurrence of dabbler and diver broods in each production area. Sampling design was standardized from 1990 until 1993 to allow better comparisons among years. These surveys provided information on annual production, breeding distribution and species composition in surveyed areas. However, these data have limitations due to inconsistencies in survey design, methodology, and observer experience. For this report, we extracted information only on species composition among geographic areas.

Other Surveys
Annual and other low-level aerial waterfowl surveys are conducted in various coastal areas of Alaska (R. King pers. comm.). Annual surveys include flights of the coastline and estuaries of southwest Alaska in October (R. King; 1980-1997) and flights of Izembek and Nelson Lagoons along the lower Alaska Peninsula (C. Dau, pers. comm.). These were conducted primarily to monitor population size and habitat use by emperor geese and black brant, but eiders and other sea ducks were counted as well. Other aerial surveys include project or species specific efforts in various geographic areas of the state summarized in numerous published and unpublished reports (e.g. Gill et al. 1978). In most cases, aerial surveys were conducted near-shore in fixed-wing aircraft with two or more observers. Few pelagic aerial surveys have been conducted in fall with most related to studies of petroleum leasing areas of the outer continental shelf (Lensink and Bartonek 1976a, 1976b, Gill et al. 1978).

SPECIES REVIEWS

Eiders - general

Population Status and Trends: The NAWBPS provides a combined-species eider population index consisting mostly of spectacled and common eiders because very few king and Steller's eiders occur in the surveyed areas. Within the 12 survey strata (Fig.1), eiders are seen only in small portions of the four coastal tundra strata of western Alaska, including the YKD, Seward Peninsula, Bristol Bay and Kotzebue Sound (Hodges et al. 1996). The eider population index has declined sharply with numbers falling 90% in the survey area (Hodges et al. 1996). Average population size in Alaska from 1957-67 was 57,800 eiders and only 9,200 eiders between 1989-1998 (Conant and Groves 1998). Although sampling intensity of eider breeding habitat within the surveyed areas is low, this long-term data set indicates a serious population decline (Stehn et al. 1993).

There are no estimates of winter population size or trend for common, king and Steller's eiders statewide because Alaska does not participate in the comprehensive winter waterfowl inventory conducted in the lower 48. The only annually-repeated winter aerial surveys of eiders were of those wintering in the Kodiak Archipelago, which were conducted for three consecutive years: 1992-94 (Larned and Zwiefelhofer 1995). However, the short time span and inconsistencies in coverage render data from these surveys inadequate for determination of trends.

Status and trends of individual eider species are discussed below.

Harvest: Eiders are taken by subsistence hunters in northern, western and southwestern coastal Alaska. Paige and Wolfe (1997) estimated that 16,000 eiders are taken annually by subsistence hunters in Alaska and that 67% were king eiders, 25% were common eiders and the remainder were spectacled and Steller's eiders. However, species identification was not determined in some communities thus species composition was based on broad assumptions. King eider, which only occurs on the YKD during migration, is the predominate species in the eider subsistence harvest there: averages of 2,807 king eiders, 410 common eiders and 233 spectacled eiders have been reported taken per year since 1987 (Wentworth 1998). Recent subsistence harvest surveys indicate that a total of <200 spectacled eiders were taken at Wainwright and Barrow in 1988

(Braund et al. 1989a, 1989b). Other villages along the Alaska coast within eider nesting and migration range have either not been surveyed or the surveys did not inquire about individual species.

Common Eider (*Somateria mollissima*)
Population Status and Trends: **DECLINING IN WESTERN ALASKA, POSSIBLY DECLINING ON NORTH SLOPE**
The Pacific race of the common eider declined severely as a breeding species in western Alaska since the late 1950's (Hodges et al. 1996) and probably in the Russian Far East since the early 1970's (Goudie et al. 1994). Eiders on the NAWBPS, primarily spectacled eiders and common eiders, have exhibited a sharp decline as a group in western Alaska with numbers falling over 90% on the YKD (Stehn et al. 1993, Hodges et al. 1996) (Fig. 3).

Common eiders breeding along the ACP of Alaska are primarily found on barrier islands where successful nesting is sporadic due to climatic conditions and predation by foxes and gulls (Schamel 1978, Johnson and Herter 1989, K. Moiteret, pers. comm.). Lack of comprehensive nesting surveys and standardized survey methods along the Arctic coast confounds the interpretation of population trend data. An aerial survey of islands and lagoons along the Beaufort Sea coast was conducted during summer 1998 by USFWS personnel but data, including observations of common eider brood creches, have not yet been analyzed.

Spring migration counts at Point Barrow suggest that numbers of common eiders nesting in northern Alaska and the western Canadian arctic may have declined by 38% from 1976 to 1987 and 54% between 1976 and 1994 at a rate of approximately 4.5% per year (Suydam et al. 1997). In spring 1987, migration counts of eiders passing Point Barrow provided an estimate of 95,069 common eiders, considerably greater than 1994 estimates of 71,164 birds in the spring and 67,145 in the fall (Suydam et al. 1997). Estimates of the numbers of common eiders were considerably lower in 1987 and 1994 than counts recorded earlier during the last 30 years (Thompson and Person 1963, Johnson 1971, Woodby and Divoky 1982). Common eider numbers passing Point Barrow in 1976 were estimated at 150,000 (Woodby and Divoky 1982).

King and Lensink (1971) proposed a possible summer population of 75,000 common eiders in Alaska based on averages from the NAWBPS, 1957-70, with an estimated 51,000 on the principal breeding ground on the coast of the YKD. An estimated 2,300 nests (at least 4,600 breeding adults) were present on the YKD in 1998 (Bowman et al. 1998) suggesting a dramatic overall decline may have occurred over the past two decades. Trend data based on YKD nest plots indicate a slightly increasing population since nest surveys were initiated in 1986 (Fig. 4). Similarly, the YKD coastal zone aerial survey indicates a slowly increasing common eider population since 1988 (Fig. 4).

Population trends for common eiders on the west coast from St. Michael to Point Hope are difficult to determine from available data. Seward Peninsula estimates from the NAWBPS survey averaged 4,900 birds from 1957-70 (King and Lensink 1971). More recently, expanded breeding population surveys covering coastal wetlands from St. Michael to Point Hope produced common eider estimates of 24,459 in 1992, and 15,844 in 1993. Most of these were from the Seward Peninsula. All these estimates were adjusted using the NAWBPS eider visibility ratio of 3.58.

Common eiders nesting throughout the Aleutian Islands declined as a result of the introduction of foxes but later responded on some islands with the removal of foxes (Byrd 1992, Bailey 1993). Although an uncommon breeder along the Alaska Peninsula, common eiders appear to have declined sharply in this area (Gill et al. 1981).

Distribution: Only one of six races of common eider, *Somateria mollissima v- nigra,* occurs in the Pacific Flyway. The Pacific race breeds from Victoria Island and Kent Peninsula, Northwest Territories, Canada, west along the Beaufort Sea and Chukchi Sea coasts of Alaska and Siberia to Cape Vankarem and Chaun Bay and south along the Bering Sea coast to the Alaska Peninsula, Aleutian, Commander and Kuril Islands and the Kodiak Archipelago (Fig. 5). Extralimital breeding of the Pacific race of the common eider is to Ayan (Sea of Okhotsk) and Sitka and Glacier Bay (southeast Alaska)(Palmer 1976, Bellrose 1980).

Numbers of eiders breeding on the Alaska Peninsula and in the Aleutian Islands are unknown, but they occur from Nelson Lagoon to Attu (Bellrose 1980, Gill et al. 1981). Approximately 100 pairs breed in the Kodiak Archipelago (D. Zwiefelhofer, pers. comm.). Common eiders breed on barrier islands located along the Arctic coast (Moitoret 1998). Of the over one million common and king eiders that summer in the Beaufort Sea area (Thompson and Person 1963, Barry 1986), only about 10% to 15% are common eiders (Johnson and Herter 1989). Probably no more than 2,000-3,000 common eiders nest along the Alaska ACP (Johnson and Herter 1989). Their distribution on the ACP fluctuates in response to environmental conditions confounding interpretations of population trend data from small study areas.

Common eiders in the arctic are known to make extensive molt migrations to areas further south (Johnson and Herter 1989). Males leave the females when incubation begins during late June and early July, and head for molting areas in western Alaska (Thompson and Person 1963, Schamel 1974, Johnson and Herter 1989). Non- and failed-breeding females probably accompany the males in a molt migration to nearshore summering sites. Successful breeding females with fledged young depart breeding areas for molting sites possibly near nesting locations (Barry 1968). Female common eiders and their young move westward toward wintering areas in the Bering Sea during late August or early September (Thompson and Person 1963). There is a continual westward movement of eiders from early July until November. Eiders frequently fly low across points of land that project into the sea. One of the best known passes is at Point Barrow where Natives traditionally shoot large numbers of migrating birds (Myres 1958, Thompson and Person 1963, Johnson 1971, Suydam et al. 1997).

Common eiders may overwinter in the Arctic Ocean but most of the Pacific race are believed to winter from the Bering Sea pack ice south to the Aleutian Islands (Byrd 1992), the Kodiak Archipelago (Larned and Zwiefelhofer 1995), Cook Inlet in Alaska (Gabrielson and Lincoln 1959), and in Russia south to the Kuril Islands (Gizenko 1955, Kistchinski 1973). South of

Kodiak Island, common eiders are seen infrequently with only a very few records for British Columbia and Washington state (Bellrose 1980) and in the western Pacific rarely south to Japan (Brazil 1991). The large polynya associated with St. Lawrence, St. Matthew and Nunivak islands and the south side of the Seward Peninsula provide a winter refuge for common eiders as well as oldsquaw, king and spectacled eiders (McRoy et al. 1971, Kistchinski 1973, Divoky 1979, Everett et al. 1989, Petersen et al. 1995, Larned et al. 1995b). Because these polynyas include shallow water areas, they provide feeding opportunities for benthic feeding species.

The presence or absence of open water appears to be one of the most important factors regulating spring migratory movements of common eiders (Schamel 1974). Migrants leave the Bering Sea in late March or April. Their route to breeding areas follows the ice edge or shore leads, but many migrate farther offshore. Up to 22,000 common eiders have been counted during the Steller's eider spring migration survey, representing some unknown fraction of the population. Minor staging areas include areas offshore of the Platinum/Goodnews Bay area, the southern portion of Etolin Strait, the south side of Nunivak Island, and the Hazen Bay/Hooper Bay area (Fig. 6). The peak of spring migration at Point Barrow is about 7 June for common eiders and 25 May for king eiders (Myres 1958, Thompson and Person 1963, Johnson 1971, Woodby and Divoky 1982, Suydam et al. 1997).

***Breeding Biology*:** Common eiders in the Beaufort Sea nest singly to more or less colonially on predominately unvegetated barrier islands and spits adjacent to open coastlines and lagoons and in river deltas, initiating nests during mid to late June (Schamel 1974, Johnson et al. 1987). They have been noted as regular breeders on offshore islands throughout their range (Gudmundsson 1932, Ahlen and Andersson 1970). In the Prudhoe Bay area, common eiders nest almost exclusively on barrier islands. The propensity for nesting on such islands in the north has been attributed to the predatory activity of the arctic fox on the mainland (Lewis 1942, Larson 1960). Islands in the Beaufort Sea with higher densities than others were either farther offshore or in areas surrounded by meltwater from river mouths early in the nesting season, thereby providing a physical barrier to terrestrial predators (Moiteret 1998). On the YKD, the common eider breeds in fresh- or brackish water wetlands and is restricted to the coastal fringe.

According to Mendall (1968), common eiders do not breed until they are at least 3 years old. Pair formation occurs on wintering grounds or during spring migration. Suydam et al. (1997) observed pair bond behaviors and similar numbers of male and female common eiders during spring migration at Point Barrow in 1994, suggesting that many were paired or in the process of pair formation when they passed Point Barrow. At Amchitka Island in the Aleutians, common eiders form pair bonds in early May, with many pairs remaining in flocks up to mid-June (Kenyon 1961). Schamel (1974) observed little, if any, courtship after birds arrived on the North slope in June, suggesting that pair-bonding had already occurred. In Alaska, common eiders maintain pair bonds through the first few days of incubation, although in in late nesting years males leave before or during nest initiation (Schamel 1974). Common eiders exhibit a phenomenal homing ability (Cooch 1965, Wakeley and Mendall 1976,Bustnes and Erikstad 1993). Of 26 females banded on their nests at Cape Dorset in 1955, Cooch (1965) found 25 back on their breeding grounds the following year, most within 62m of their previous nest sites.

Western race common eiders appear to nest less densely than the eastern races; no dense colonies have been reported in Alaska. Highest densities reported were 10.4/hectare on one island in the Beaufort Sea (Moiteret 1998).

Timing of break-up near breeding islands seems to govern the onset of nesting (Schamel 1974). Eiders may postpone nesting attempts until the islands are surrounded by open water. Near Prudhoe Bay, Alaska, nest initiation began in 1972 on June 20, peaked June 24-27, and ended July 16 (Schamel 1974). Many eiders use old nest sites, which are either in natural cup-shaped hollows or ones formerly scraped out by hens.

Male common eiders do not participate in nest site selection and defense. The males accompany the female to potential nest sites but if aggressive encounters occurred at these sites, the outcome of bouts between females, not males, determined site ownership. Early-nesting birds maintained their pair bond through the first few days of incubation, whereas late-nesting birds broke pair bonds prior to or during nest initiation (Schamel 1974).

Common eiders tended to choose sites that offered a visual barrier to predators, protection from the prevailing winds, and sufficient elevation to avoid flooding during normal shifts in water level (Schamel 1974). Schamel (1974) considered *Elymus* grass to be the cover type most preferred by common eiders. Common eiders located their nests within a 1 m range of elevation on Egg Island in the Beaufort Sea. If wind protection was available, they nested fairly high on gravel ridges. At low elevations, these birds appear to be limited in their choice of sites, perhaps by dampness and proximity to water. Areas <20 cm above sea level are subject to flooding during normal summer storms. Common eiders nesting on two islands in the Beaufort Sea showed strong affinity for areas with driftwood, and hatching success was positively correlated with driftwood density (Johnson et al. 1987) .

Clutch size varies little among races of common eider; the Pacific race averaged 4.25 eggs per clutch (Bellrose 1980). Average clutch size on the YKD from 1986-98 was 4.9 (Bowman et al. 1998). Near Prudhoe Bay, Alaska, Schamel (1974) determined that the incubation period for 11 nests averaged 26 days (range 21-28, using the last egg laid as initiation date). Some females begin incubation with the laying of the first egg, but most begin incubation with the laying of the third egg. The common eider renests more than any other sea duck in North America because its breeding season is long relative to other sea ducks (Cooch 1965). Common eiders frequently form large amalgamated broods called creches (Guignion 1967). Creches may be attended by females that successfully hatched broods as well as nonbreeding, failed-nesting, or brood-abandoning females, although generally only the former play a significant role in brood defense (Bustnes and Erikstad 1991).

Females feed little or not at all during incubation and rely on nutrient reserves, especially pectoral muscles and fat deposits, for energy while incubating. Females may lose 50% of their prelaying weight during incubation (Korschgen 1977).

Diet: Animals composed >95% of the diet of common eiders from various areas in North

America, with blue mussels the single most important food item (Cottam 1939). In Canada the common eider is sympatric with the blue mussel, though this relationship applies principally to wintering and staging areas where most studies have been conducted (Barry 1986). In the breeding season a more varied diet is often evident. Also in the Chukchi and Beaufort seas, ice often scours the shoreline and nearshore bottom affecting the presence and abundance of sessile benthic fauna and flora. For that reason, Divoky (1979) proposed that sea ducks feeding in such areas instead concentrate on motile benthos species such as mysids, amphipods, and isopods.

Horse crabs and box crabs were particularly important to eiders from Alaskan waters. The amount of plant foods consumed is insignificant.

Threats and Mortality Factors: Over most of the eider's range, the destruction of eggs by gulls is the single greatest cause of nest loss. All of the eider nests destroyed on Egg Island, near Prudoe Bay, Alaska, owed their destruction to glaucous gulls (Schamel 1974). Gulls devoured 42% of eggs laid; 71% of these losses occurred during egg-laying and 29% after females deserted their nests. Eiders may derive some protection from other gulls and predators by nesting within the territory of a nesting gull. Although most avian predators cannot dislodge incubating common eider females from their nests, most mammalian predators are able to do so (Barry 1968). Arctic fox are the most significant mammalian predator. A colony of nesting common eiders in northwest Alaska was destroyed when a single arctic fox cached 500 eggs and killed one adult female (Quinlan and Lehnhausen 1982). Eiders eject foul smelling excreta when frightened from their nests, which may be an adaptation to deter predation of eggs by foxes (Beetz 1916, Gudmundsson 1932). Other mammalian predators include polar and grizzly bears and reindeer (D. Schamel, pers. comm). Populations of glaucous gulls, common ravens, and arctic foxes may be increasing in the Arctic due to access to human refuse associated with permanent settlements (Day 1998).

Milne (1963) estimated that half of adult female annual mortality in common eiders occurred during the brood-rearing period. Low water levels may reduce duckling survival directly by decreasing duckling's abilities to avoid predators or by influencing food availability (Swennen 1991), or by forcing broods to move to salt water earlier than usual. Swennen (1983) suggested that common eider ducklings experienced considerable mortality within a week after introduction to salt water.

Common eiders are a locally important subsistence species for Native peoples in Alaska and Canada. An estimated 2,475 common eiders are taken in northwestern Canada and in northern and western Alaska annually, including both subsistence and sport harvest (Fabijan et al. 1997). Most harvested birds are adults taken during spring and molt/fall migrations (Paige and Wolfe 1997). Sport harvest of Beaufort Sea eiders is minimal because eiders inhabit remote areas largely inaccessible to sport hunters (R. Suydam, pers. comm.). Because of their propensity to nest colonially in the Beaufort Sea, common eider eggs are more susceptible to subsistence egging than other eider species, but no data exist on the magnitude of take (R. Suydam, pers. comm.). An average of 410 common eiders were reported taken annually on the YKD from 1987-97.

Eiders are particularly vulnerable to oil spills because they congregate in large, dense, flocks during winter, molting, and migration. High concentrations of nesting common eiders on several islands in the Beaufort Sea may make them particularly vulnerable to impacts from offshore oil development, which is increasing in the area (Moiteret 1998). Oil may cause direct mortality of adults and young, or cause embryonic mortality if transferred to eggs (Albers and Szaro 1978). Johnson et al. (1987) found that common eiders nesting on Thetis Island in the Beaufort Sea were tolerant of industrial activity, mainly helicopter overflights.

There is circumstantial evidence suggesting an inverse relationship between common eider and sea otter abundance in the Aleutians. Periodic surveys over the past 20 years indicated that common eiders have decreased where sea otters increased, and vice versa (D. Irons, pers. comm.). The mechanism for this relationship is unclear, but may involve competition for invertebrate food.

King Eider (*Somateria spectabilis*)

Population Status and Trends: **STABLE ON ARCTIC COASTAL PLAIN; DECLINING IN WESTERN CANADIAN ARCTIC**

There is no information indicating a decline in the number of king eiders on the North slope of Alaska. An average estimated 13,128 eiders (mostly king eiders; 59%) were observed on the ACP breeding pairs survey during 1990-98; populations seem stable or increasing (Fig. 7) (King and Brackney 1997). This figure incorporated the standard NAWBPS visibility correction factor of 3.58. The unadjusted average is 3,667 birds. The North slope eider survey, timed earlier than the ACP breeding pairs survey, averaged 12,333 birds with a stable trend from 1993-1998 (no visibility correction used) (Larned and Balogh 1997) (Fig. 7).

Recent counts of migrating king eiders at Point Barrow are not directly comparable with past estimates, yet they provide convincing evidence of a decline (Suydam et al. 1997). The apparent decline may represent actual population declines or, possibly, a dramatic shift in the migration route. Surveys indicate that the population nesting in northern Alaska and the western Canadian Arctic has declined 31% from 1976 to 1987 and 54% from 1976 to 1994 (Suydam et al. 1997). Similarly, aerial surveys conducted for three years in the early 1990's (Dickson et al. 1997) suggest >70% decline in the western Canadian Arctic breeding population since 1960 (Barry 1968), although these data should be interpreted cautiously because survey methods were not directly comparable between these two surveys. Reasons for the decline are unknown.

Distribution: The king eider has a circumpolar distribution, breeding in the high-arctic and wintering as far north as seas remain open (Bellrose 1980) (Fig. 5). The Alaskan breeding population occurs primarily on the ACP from the Point Hope/Cape Thompson area east at least to Humphrey point (Gabrielson and Lincoln 1959). The greatest concentration of nesting king eiders in Alaska is between the Colville River Delta and the Arctic National Wildlife Refuge where they utilize a broad range of ponds of variable depth and size, generally favoring deeper ponds with less emergent vegetation, as compared with spectacled eiders. (Derksen et al. 1981, Johnson and Herter 1989, King and Brackney 1997, Larned and Balogh 1997). The only confirmed breeding records for the Seward Peninsula are from Cape Espenberg (Schamel et al.

1979). There is only one recent breeding record of the king eider reported for the YKD; at Kigigak Island in 1993 (Yukon Delta NWR files). Fay and Cade (1959) did not find nests or broods on St. Lawrence Island despite reports of occasional breeding of eiders from local residents. W. Eldridge (pers. comm.) estimated a minimum population of 56,000 king eiders in Russia based on aerial surveys conducted in 1993-95

King eiders nest on shores of fresh water tundra ponds of the ACP (Bellrose 1980) and less commonly on coastal barrier islands (Schamel 1974). Barry (1986) believed that the majority of king eiders that migrate through the Beaufort Sea nest on arctic islands and the ACP of Alaska and northwestern Canada.

Males undergo a molt migration from early July through August, after females start incubation, to molting areas in the Chukchi and Bering seas (Myres 1958, Thompson and Person 1963, Johnson 1971, Cotter et al. 1997). The Bering and Chukchi seas are the primary molting and wintering areas for king eiders that breed in eastern Russia, Alaska, and western Canada (Kistchinski 1973, King and Dau 1997, CAFF 1997, Dickson et al. 1998). Suydam et al. (1997) observed adult plumaged male king eiders in flocks migrating past Point Barrow in September and October, indicating that some adult male king eiders molt in the Beaufort Sea as well. Females start migration in mid-August and continue into September (Suydam et al. 1997). Young-of-the-year king eiders are the last to leave breeding areas in September and October and arrive at Nunivak Island as early as the third week of September (C. Dau pers. comm.). King eiders migrate south past Cape Romanzof along the central YKD in mid-August (McCaffery and Harwood 1997). Little is known about the movements of nonbreeders. As many as 2,000 nonbreeding king eiders were recorded offshore of St. Lawrence Island (Fay 1961).

King eiders implanted with satellite transmitters in 1997 and 1998 on their nesting grounds on Victoria Island, Northwest Territories, Canada, were tracked to their molting areas in both Russian and Alaskan waters of the Bering and Chukchi Seas (Dickson et al. 1998). Aerial surveys were subsequently conducted in fall of 1997 and 1998 to verify and evaluate the Alaskan locations (Larned and Tiplady 1998a, 1998b). Mimimal estimates of king eiders from these surveys included: Kvichak Bay (7,156 on 10/3/97; 19,285 on 9/21/98); Kuskokwim Bay, offshore near Platinum Village (4,802 on 9/29/97); southeast St. Lawrence Island (24,284 on 9/21/98). There were also six molting locations along the Russian Coast from Mechigmenan Bay to the base of Kamchatka Peninsula that were not surveyed.

King eiders winter in the Bering Sea in polynya south of island groups, along the Alaska Peninsula, in the Aleutian and Pribilof islands, south to the Kodiak Archipelago (McRoy et al. 1971, Byrd 1992, Larned and Zwiefelhofer 1995). Wintering king eiders occur around Kodiak Island (R. MacIntosh pers. comm.) and at Dutch Harbor in the Aleutians (Cahn 1947) by early December. The large polynya associated with St. Lawrence, St. Matthew and Nunivak islands and the south side of the Seward Peninsula provide a winter refuge for king eiders (Fay and Cade 1959, Fay 1961, McRoy et al. 1971, Kistchinski 1973, Divoky 1979, Everett et al. 1989, Petersen et al. 1995). In the Russian Far East, king eiders winter off the east and south coasts of Chukotka Peninsula and in small numbers south to Kamchatka, Sakhalin Island, the northern Kuril Islands

(Gizenko 1955), and rarely south to Japan (Brazil 1991). There are a few records of king eiders wintering as far south as California (Roberson 1980).

King eiders begin to leave wintering areas in early April and may not reach their breeding grounds until mid-June. Because king eiders migrate offshore (often several km offshore), counts represent only a small fraction of the population. Up to 242,000 king eiders have been counted during the Steller's eider spring migration surveys in April. Of those 242,000 king eiders, 187,400 were observed in Kvichak Bay in upper Bristol Bay and consisted of mostly breeding adults (adult plumage, 1:1 sex ratio with uniform distribution of sexes within flocks) (Larned 1998). Distribution of king eiders was consistent among years. Other important spring staging areas include Port Moller and Port Heiden (Fig. 8). Occasionally, large flocks of immature-plumaged king eiders are seen along shore and in the mouths of major lagoons and bays of the Alaska Peninsula. The highest total for juveniles was 42,254 in 1997. Smaller flocks of juveniles are also typically seen on the south side of Nunivak Island (Larned 1998).

Documented migration at places where the migrants pass close to land include: Dall Point and Hooper Bay on the YKD (Murie 1924, Dufresne 1924, Conover 1926, Brandt 1943), Nome and Wales on the Seward Peninsula, Cape Lisburne, Wainwright, Barrow, and Humphrey Point (Bailey 1948, Gabrielson and Lincoln 1959). Up to 90% of the eiders observed migrating past Point Barrow in most years are king eiders (Myres 1958, Thompson and Person 1963, Johnson 1971, Woodby and Divoky 1982, Suydam et al. 1997). Radar observations at Point Barrow have confirmed that king and common eiders follow a course that would take them far offshore (W.L. Flock in Johnson and Herter 1989). Offshore open water in the Beaufort Sea pack ice is a major determinant of the routing and timing of spring migration of king eiders (Barry 1986).

Timing and magnitude of the migration of Alaskan and Canadian breeding king eider has been monitored for several years at Point Barrow. Numbers of king eiders were considerably lower in 1987 and 1994 than counts recorded over the last 30 years (Thompson and Person 1963, Johnson 1971, Woodby and Divoky 1982). King eider numbers passing Point Barrow in 1976 were estimated at approximately 800,000 (Woodby and Divoky 1982). In spring 1987 an estimated 556,000 king eiders passed Point Barrow (Suydam et al. 1997). In 1994, 373,000 king eiders were counted in the spring and 301,000 in the fall.

***Breeding Biology*:** King eiders nest on small islands along the coast or near tundra ponds and lakes inland from the coast. Unlike common eiders, which customarily nest in colonies, king eiders usually breed as widely dispersed pairs over tundra dotted with innumerable ponds. They use freshwater habitats for feeding as well as nesting and therefore can take advantage of the first meltwater pools, which form before marine habitats become ice-free (Lamothe 1973, Abraham and Finney 1986). This enables king eiders to nest earlier and farther north than other eider species (Lamothe 1973, Palmer 1976, Johnson and Herter 1989). They utilize a broader range of pond depths and sizes than do spectacled eiders, generally favoring deeper ponds with less emergent vegetation (Larned and Balogh 1977).

Based on observations of predominantly male eiders early in spring migration, Woodby and

Divoky (1982) and Barry (1986) suggested that pair formation in king eiders likely occurs in polynya offshore of nesting areas. Suydam et al. (1997), however, observed pair bond behaviors and similar numbers of male and female king eiders during spring migration at Point Barrow in 1994, and suggested that many king eiders were paired or in the process of pair formation when they passed Point Barrow. Adult king eiders seen on staging areas during the Steller's Eider Spring Migration Survey (mid-April) are mostly paired.

King eiders begin to nest in the high arctic the last half of June, from 2-3 weeks after their arrival. Nest initiation extends over a period of approximately 2 weeks (Lamothe 1973, Cotter et al. 1997, Holcroft-Weerstra and Dickson 1997). Few nests are started after 10 July. Schamel (1974) reported that king eiders near Prudhoe Bay began nesting inshore on June 19 and on offshore islands on July 4. Incubated clutches range in size from 2-6 eggs and average 4.92 (n=53). The incubation period is 23-24 days (Parmelee et al. 1967). The short span of nesting and the early departure of drakes from the nesting grounds preclude any significant renesting by king eiders. King eiders probably do not breed until at least their second year. There is little information on nesting success for King Eiders.

Diet: King eiders share with oldsquaws an unmatched reputation for their deep-diving ability. There is a record of one king eider feeding on the bottom in 55 m of water in the Bering Sea (Preble and McAtee 1923). About 95% of the food items consumed are animal (Cottam 1939): mollusks, 46% (of which blue mussels constituted 20%); crustaceans, 19% (half are king crabs); and echinoderms, 17% (sand dollars, sea urchins). Caddisfly larvae and sea anemones comprise most of the other animal foods. Eelgrass, widgeon grass, and algae are also eaten. Salomonsen (1950-51) reported that during summer the females and young feed entirely in fresh water, where their food is principally midge larvae and aquatic vegetation.

Threats and Mortality Factors: King eiders are subject to natural calamities such as the periodic strandings and starvation along the northern Alaska and Canada coasts during spring migration when wind and ice conditions close off open water in traditionally used polynya (Barry 1968). Because male king eiders are the first migrants of the spring season they are most seriously affected (Barry 1968). Some eiders may also be caught by ice in the fall. Barry (1968) found the remains of 125 king eiders, mostly unfledged young and a few adult females, frozen in a lake in the fall on Banks Island. An estimated 100,000 eiders, mostly king eiders representing approximately 10% of the Canadian western arctic breeding population, died from apparent starvation in 1964 during the spring migration (Barry 1968, Fournier and Hines 1994). Given the low productivity of king eiders in most years (Lamothe 1993, Goudie et al. 1994), populations may take decades to recover from such mass mortalities (Fournier and Hines 1994).

The most significant predator of king eider nests and eggs is the arctic fox (*Alopex lagopus*) (Larson 1960). Jaegers will also destroy nests (Parmelee et al. 1967). According to Manning (1956), foxes apparently take a large number of eggs and young, particularly after a crash in the lemming population.

King eiders are an important subsistence species for Native peoples in Alaska and Canada. An estimated 20,000 king eiders are taken in northwestern Canada and in northern and western Alaska annually, including both subsistence and sport harvest (Fabijan et al. 1997). Most harvested birds are adults taken during spring and molt/fall migrations. Sport harvest of Beaufort Sea eiders is minimal because eiders inhabit remote areas largely inaccessible to sport hunters (R. Suydam, pers. comm.). Subsistence harvest of king eider eggs is probably minimal (R. Suydam, pers. comm.). In Alaska, king eiders were mostly taken during migration for subsistence use (Paige and Wolfe 1997). King eiders only occur on the Yukon-Kuskokwim Delta during migration and are the predominant eider species in the subsistence harvest there: an estimated average of 2,807 king eiders were reported taken annually from 1987-97 (Wentworth 1998).

There is no evidence suggesting heavy metals are contributing to population declines of king eiders in the Beaufort Sea (R. Suydam, pers. comm.). Lead poisoning, as a result of ingesting spent lead shot, is not likely to be a significant problem for king eiders of the Beaufort Sea because most birds nest away from hunting areas, although some lead poisoning may occur near traditional hunting areas (R. Suydam, pers. comm.).

Eiders are particularly vulnerable to oil spills because they congregate in large, dense, flocks during winter, molting, and migration. At least 1,609 king eiders were killed as a result of oiling following a collision between a freighter and a crab processing vessel in the Bering Sea near St. Paul Island, Alaska, in February 1996 (Flint et al. 1998).

Spectacled Eider (*Somateria fischeri*)

***Population Status and Trends:* WESTERN ALASKA POPULATION DECLINED, NORTHERN ALASKA POPULATION SUSPECTED TO HAVE DECLINED, WORLDWIDE POPULATION CLASSIFIED AS THREATENED**

The NAWBPS and other more recent surveys indicate that numbers of spectacled eiders breeding on the YKD dropped by about 94% from about 48,000 pairs in the 1970s to <5,000 by 1992 (Stehn et al. 1993) (Fig. 3). The YKD breeding population continued to decline by 9-14%/year through 1992 although surveys suggest the population now stands at about 8,000 birds and has stabilized or increased slightly from 1992-1998 (Bowman et al. 1998, Eldridge et al. 1998) (Fig. 9). The NSE survey suggests a fairly stable trend from 1993-1998 (Larned et al. 1999) (Fig. 9).

In May 1993 the spectacled eider was listed as a threatened species under the Endangered species Act of 1973. The primary reason for listing spectacled eiders was their rapid decline on the YKD breeding grounds (Federal Register 58(88):27474-27480).

The highly gregarious wintering population of spectacled eiders in the northern Bering Sea has been estimated at 363,000 birds (Larned and Tiplady 1999) however, trend is unknown as historical data are lacking. Circumstantial evidence suggests that the vast majority of the worldwide population of spectacled eiders winters at this location during most years.

Distribution: Spectacled eiders have been reported breeding discontinuously from the Nushagak

Peninsula, Alaska, north to Barrow and east nearly to the Yukon Territory (Dau and Kistchinski 1977, Garner and Reynolds 1986, Johnson and Herter 1989)(Fig. 10). Nesting was also reported on St. Lawrence Island, Alaska, historically (Fay and Cade 1959) and as recently as 1997 (S. Stephensen, pers. comm.). In Russia, spectacled eiders were reported to nest from the northern Chukotka Peninsula west to the Lena River Delta, on Wrangel Island, and Novosibirski Islands (Kistchinski 1973). Based on nest surveys (corrected for nest detection), about 8,000 birds breed on the YKD (Bowman et al. 1998). Current minimum estimated populations (uncorrected for aerial detection) are 9,500 along the North slope (Larned et al. 1999), and 146,000 in Arctic Russia (W. Eldridge, pers. comm.).

The only known wintering area for any population is in offshore waters south of St. Lawrence Island. Aerial surveys indicate a wintering population of about 363,000 (Larned and Tiplady 1999). This is believed to represent the worldwide population of spectacled eiders.

Major molting areas are offshore waters in Ledyard Bay and eastern Norton Sound, Peard Bay, and Mechigmenan Bay and the Indigirka-Kolyma Delta region, Russia (Kistchinski 1973, Larned and McCaffery 1993, Laing and Platte 1994, Larned et al. 1995a, 1995c, 1995d)(Fig. 10). Larned et al. (1995c) estimated about 41,000 spectacled eiders were molting at Mechigmenan Bay on 21-22 August, 1994. Up to 4,000 eiders molt in eastern Norton Sound, several hundred molt at Peard Bay, and the highest estimate for Ledyard Bay was 33,192 on 21 September 1995 (Laing and Platte 1994, Larned et al. 1995a).

Migration routes in spring and fall are not well known but are most likely direct routes between breeding sites and molting and wintering areas (Petersen et al. 1995). The arrival of spectacled eiders on the YKD from the northwest in spring may be evidence of direct routes (Dau and Kistchinski 1977, McCaffery et al. 1998).

***Breeding Biology*:** Spectacled eiders breed in low-lying, coastal arctic and sub-arctic wetlands dominated by graminoids and characterized by numerous shallow ponds and lakes (Kistchinski and Flint 1974, Dau 1974). On the YKD, spectacled eiders are primarily dispersed nesters, often associated with other waterbird species (Dau 1974, Strang 1976). Johnsgard (1964), however, found spectacled eider nests clumped at some sites on the YKD, suggesting a degree of "incipient colonialism". Nests are near water and susceptible to both avian and mammalian predation, which varies both annually and geographically on the basis of predator and prey densities (Kistchinski and Flint 1974, USFWS 1996).

Nesting habitat for spectacled eiders on the YKD are within the YDNWR or on lands owned by various Native village corporations. The historically dispersed human population in this area has expanded and converged into large, permanent villages. Hunting and other forms of disturbance in habitats used frequently by humans may have altered the distribution and habitat used by spectacled eiders and other species on the YKD (Nelson 1887, Brandt 1943, Kertell 1991, Stehn et al. 1993). Important habitats for arctic-breeding spectacled eiders include large river deltas, tundra rich in lakes, and wet, polygonized coastal plains with numerous water bodies. Along the arctic coast of Alaska, spectacled eiders are seen most commonly during the breeding season near *shallow-Arctophila* and shallow-*Carex* ponds (Derksen et al. 1981, Warnock and Troy 1992, Anderson and Cooper 1994), which are flooded but vegetated, with low islands or ridges suitable as nest sites.

At least some female spectacled eiders exhibit strong fidelity for nesting areas (Dau 1974). On the YKD, females nested within 1.5 km of their previous nest sites (Dau 1974, Harwood and Moran 1993, Moran 1996). Genetic analyses also indicate high site fidelity to nesting areas (J. Pearce, pers. comm.). This tendency has important implications for protecting and recovering specific geographic populations.

Age at first breeding has not been determined but probably occurs most often in the third year for females and the third or fourth year in males, coinciding with the acquisition of definitive plumage (Portenko 1972, Palmer 1976, Skakuj 1990). Breeding as early as two years of age has been documented among wild and captive spectacled eiders. On the YKD, 1 of 2 banded females returned when ≥7 years and the other when ≥8 years (C. Dau, pers. comm.). Few data are available on reproductive senescence and overall longevity for males or females.

Spectacled eiders arrive on the breeding grounds paired, often in small flocks, at breeding areas in mid-May in subarctic (YKD) (Dau 1974), and in late May to early June in arctic portions of their range (Kistchinski and Flint 1974, Anderson and Cooper 1994, Smith et al. 1994). Equal proportions of adult males and females are observed during spring migration, whereas subadults are rarely seen (Dau and Kistchinski 1977, P. Flint, pers obs., J. Grand, pers. obs.). Male spectacled eiders begin leaving breeding areas during incubation, and a substantial portion have departed breeding areas by mid June in the sub-arctic (Dau 1974, J. Grand, pers. comm.). Males take no role in incubating or brood rearing.

On the YKD, nest initiation occurs approximately 7 days, and peaks about 12 days, after first arrival (Dau 1974). On the North slope, peak observations of pairs occur in mid-June (Smith et al. 1994). Spectacled eiders lay one egg per day and begin incubation with the last or penultimate egg (Dau 1974). Incubation lasts 20-25 days (Dau 1974, Kondratev and Zadorina 1992, Moran and Harwood 1994) and typically is synchronous among nests within a region and in a given year (Dau 1974, J. Grand, pers. comm.). Most eggs on the YKD hatch between 20 June and 2 July, but hatching may begin in mid-June or extend to mid-July, depending on the time of snow melt and the synchrony of nest initiation (Bowman et al. 1998). Hatch occurs up to 2 weeks later in the arctic. Nests that are initiated early are more likely to be successful than nests initiated later (Dau 1974, USFWS 1996).

Spectacled eiders lay an average of 5 eggs, although clutch size varies among years and locations (Bowman et al. 1998). Nesting success (the percentage of nests that successfully hatch at least one egg) on the YKD averaged 71.4 percent from 1969 to 1973 (Dau 1974). In 1991-95, nesting success at Kigigak Island on the YKD varied from 20-95% (Harwood and Moran 1991, 1993, Moran 1996). The percentage of nests remaining active at mid-incubation on random nest plots (an index to nesting success that is biased high because of nest loss after plot search) averaged 84% from 1986-98 (Bowman et al. 1998).

Most broods are raised within 5 km of where they were hatched (Dau 1974, Harwood and Moran 1993, Moran and Harwood 1994). Initial movements away from the nesting areas may be a response to potential predation of ducklings (TERA 1995) or movements toward better brood-rearing habitat. The only quantitative measure of adult female and duckling survival is from a study at Hock Slough on the YKD: over the first 30 days of the brood rearing period in 1993-95, adult female survival averaged 93%, and duckling survival averaged 34% (Flint and Grand 1997).

Fledging occurs approximately 50 days post-hatching, after which females and their broods move directly from freshwater to marine habitats (Dau 1974, Kistchinski and Flint 1974). Dau (1974) believed that physiological stresses occurring partially as a result of this abrupt shift from freshwater to marine habitats may cause significant juvenile mortality.

Most spectacled eiders in both the arctic and subarctic nesting areas occur in coastal habitats. The coastal fringe of the YKD is the only high-density Spectacled eider (3.0 - 6.8 birds/km^2) subarctic breeding habitat (Dau and Kistchinski 1977, USFWS 1996). In this area, nesting is restricted to low, wet sedge and grass marshes with numerous small, shallow water bodies, primarily along shorelines, peninsulas or on islands (Dau 1974, Moran and Harwood 1994). Nests rarely occur more than 190 m from water. These habitats can be inundated by extreme high tides or storm surges (King and Dau 1981).

Female spectacled eiders rear their broods in shallow ponds and lakes with emergent vegetation, in basin wetland complexes and on deep open lakes (Dau 1974, Kistchinski and Flint 1974, Derksen et al. 1981, Anderson and Cooper 1994). Grand and Flint (1997) found that females selected areas of low to moderate salinity for brood rearing.

On the North slope, breeding spectacled eiders were observed at low densities along the coast in large shallow productive thaw lakes, usually with convoluted shorelines and/or small islands (Larned and Balogh 1997). In the arctic, Derksen et al. (1981) found spectacled eider broods associated with shallow-Carex and deep open Arctophila lakes. Ponds with emergents are important brood-rearing habitats (Warnock and Troy 1992, Anderson and Cooper 1994, Anderson et al. 1995).

Diet: On their nesting grounds, spectacled eiders feed primarily by dabbling in shallow fresh or brackish ponds, or on flooded tundra (Dau 1974, Kistchinski and Flint 1974). Cottam (1939) analyzed foods of 16 adults collected in May-July (possibly including migrants) and found that animal food, primarily mollusks, comprised 75 percent of stomach contents. Cranefly larvae *(Prionocera spp*) dominated diet of adults during pre-breakup on the YKD (Dau 1974) and during June on Arctic NWR (Kistchinski and Flint 1974**)**. Insects in general dominated all age-class diets after break-up (Dau 1974, Kistchinski and Flint 1974). Ducklings feed primarily on small freshwater crustaceans. Plants were taken by all age classes, particularly *Potamogeton* seeds (Dau 1974) and *Ranunculus* seeds (Kistchiniski and Flint 1974), which may act as stomach gastrolites in the absence of available gravel. Upland feeding on *Empetrum nigrum* (crowberry) also has been recorded (Cottam 1939, Dau 1974).

Few data are available on the diets of spectacled eiders at sea. Cottam (1939) found primarily amphipods, as well as mollusks, in 2 birds collected at St. Lawrence Island in January. The most common foods eaten by spectacled eiders that were shot by subsistence hunters in May and June near St. Lawrence Island were mollusks and crabs (USFWS 1996).

Threats and Mortality Factors: Predation, spring and summer subsistence harvest (Wentworth 1998), and lead poisoning from ingested lead shotgun pellets may have contributed to the rapid decline observed on the YKD (Franson et al. 1995b). Adult female spectacled eiders (and probably ducklings) were killed by predators and lead poisoning on the YKD (Flint and Grand 1997).

Lead poisoning, resulting from the ingestion of spent shot, was identified as a cause of mortality in spectacled eiders on the YKD. Flint et al. (1997) detected lead shot in the gizzards of 11.6% of spectacled eiders X-rayed in the field along the lower Kashunuk River drainage. Thirteen percent of adult females and 6.6% of adult males had elevated blood lead levels. The proportion of females exposed to lead increased from pre-nesting (13%) through hatch (25.3%) and brood-rearing (35.8%). Adult female spectacled eiders exposed to lead prior to hatching their eggs survived at a much lower rate than females not exposed (Grand et al. 1998). Lead shot may be available to waterfowl for many years, even after the use of lead shot is curtailed (Flint 1998). Sublethal lead exposure by breeding hens may reduce nesting and brood-rearing success (Flint et al. 1997). The extent of lead exposure in breeding hens among areas on the YKD is currently under investigation.

Eiders may be accumulating environmental contaminants from sources within the marine environment that cause mortality, reduce propensity for nesting, reduce productivity, or reduce juvenile survival (USFWS 1996). Elements that are known to be toxic to waterfowl (cadmium, copper, lead, selenium, and zinc) have been found at high concentrations in spectacled eiders relative to other species; of these, only lead has been directly associated with eider deaths (Franson et al. 1995a, J. Stout, pers. comm.). The exposure risk of spectacled eiders to petroleum-related compounds is unknown, but may be less than from other contaminants. Organochlorine compounds have only been found in spectacled eiders at concentrations well below toxic thresholds for other waterfowl (J. Stout, pers. comm.).

Predation by gulls, jaegars, arctic foxes and red foxes probably affects the survival of spectacled eider eggs and ducklings throughout the species' range. Nest success at Hock Slough more than doubled when mew gulls were controlled (J. Grand, pers. comm.). However, no remains of spectacled eider ducklings were found in the stomachs of 434 glaucous gulls sampled on the YKD in 1994, suggesting that glaucous gull predation on spectacled eiders on the YKD is insignificant (Bowman et al. 1997).

Spectacled eiders are largely inaccessible to most hunters during fall and winter, but a few have been taken on St. Lawrence Island. No spectacled eider wings have been received in the federal Parts Collection Survey. Sport hunting of spectacled eiders has been prohibited since 1991. Recent subsistence harvest surveys indicate that about 150 spectacled eiders were taken at

Wainwright and a maximum of 50 were taken at Barrow in 1988 (Braund 1989a, 1989b). Average subsistence harvest on the YKD from 1987-97 was 233 spectacled eiders (Wentworth 1998).

Because most of worldwide spectacled eider population amasses during winter in a small area of the Bering Sea, they may be particularly vulnerable to human disturbance (direct or indirect), environmental contamination, or possibly shifts in prey base due to long term climatic changes. Similarly, the large concentrations of molting spectacled eiders at Mechigmenan Bay, Russia, may be vulnerable to disturbance and environmental degradation (Larned et al. 1995c).

Steller's Eider (*Polysticta stelleri*)

Population Status and Trends: **DECLINED IN WESTERN ALASKA, POSSIBLY DECLINING IN NORTHERN ALASKA; CLASSIFIED AS THREATENED IN U.S.**

Worldwide population estimates for Steller's eiders have historically ranged from 400,000 (Palmer 1976) to 500,000 (Uspenski 1972). These estimates are based on limited data (especially in Russia) where most breeding birds occur. W. Eldridge and J. Hodges (pers. comm.) estimated a minimum (uncorrected for visibility) of 149,000 Steller's eiders in Russia based on aerial surveys in 1993-95. In addition to the listing of the Alaska breeding population as Threatened, Steller's eiders are presently listed in the Red Book for the Yakutsk, Autonomous Soviet Socialist Republic as a category 3 or "rare" species, due to reports of declining numbers, reduced breeding range, and illegal harvest (Solomonov 1987). There are no reported data indicating a trend for the Steller's eider population wintering in the Russian Far East, estimated at 20,000-25,000 by Pihl (1997).

The Alaska breeding population of Steller's eiders was declared a threatened species under the Endangered Species Act in June 1997 (Federal Register 62(112):31748-31757).

On the ACP of Alaska, numbers of breeding birds have apparently declined within the Barrow area, which is a center of abundance (Quakenbush et al. 1995, King and Brackney 1997, King and Dau 1997). Steller's eiders occur regularly only in the vicinity of Barrow where they are frequently the most common breeding duck. Estimates of Steller's eider derived from the ACP breeding pairs survey are highly variable and have averaged 4,800 breeding pairs from 1990-98.

Annual surveys in the vicinity of Izembek NWR during spring, molting and late fall staging periods suggest that Steller's eiders have declined by 71.4%, 53.7% and 53.9%, respectively, from 1975-1990. Numbers of wintering Steller's eiders fluctuated in response to ice conditions and showed no trend (Dau 1991). Steller's eiders counted incidentally during spring and fall emperor goose surveys in coastal southwest Alaska suggest a possible decline from 1981 to present (R. King pers. comm.). It is not known if these trends are indicative of the entire Pacific population.

Surveys in the Kodiak Archipelago from 1992-1994 indicate a stable to increasing winter population of approximately 5,000 birds (Larned and Zwiefelhofer 1995). The trend at other

Alaska staging or wintering sites is unconfirmed due to the lack of current and historic population estimates.

Distribution: Most of the Pacific population of Steller's eider breeds in Russia from the Chukotka Peninsula west to the Khatanga River (Murie 1959, Bellrose 1980, Kertell 1991) (Fig. 11). The center of breeding abundance is the eastern Russian arctic primarily from the Lena River east to the Kolyma River (Kistchinski 1973) where aerial surveys indicate a minimum of 149,000 individuals (Hodges and Eldridge, unpubl. data). Band returns from Steller's eiders banded on the Alaska Peninsula wintering grounds indicate that most Alaska-wintering Steller's eiders breed along the Arctic coast of Siberia (Jones 1965, Dau 1985) (Fig. 12). An apparently distinct Steller's eider population that winters in Europe, estimated at 30,000-50,000 birds, breeds in Russia from the Taimyr Peninsula west to the Yamal Peninsula (Pihl 1997).

The historic breeding range of Steller's eider in Alaska was reported as discontinuous from the eastern Aleutian Islands along the west and northern coasts of Alaska to the Yukon Territory (Gabrielson and Lincoln 1959). Their breeding range in this century spanned the entire ACP from Wainwright to Demarcation Point, and the YKD (Gabrielson and Lincoln 1959, Kertell 1991) (Fig. 11). As many as 3,500 breeding pairs were estimated breeding on the Yukon-Kuskokwim Delta in the late 1950's but this population declined rapidly in the 1960's (Kertell 1991). Although Kertell (1991) concluded that Steller's eiders were "apparently extinct" on the YKD, recent findings of a few nests indicate Steller's eiders still nest there, but at densities greatly reduced from reported historical levels (Flint and Herzog, in press). Breeding Steller's eiders on the ACP, most common near Barrow, may also have declined (Kertell 1991, Quakenbush et al. 1995).

After the breeding season, Steller's eiders undertake a molt migration to sheltered marine estuaries where they molt and in some cases overwinter. Concentrations of molting Steller's eiders have been observed near Bering Sea islands and headlands and in estuaries from southwest Alaska to the northern shore of the Alaska Peninsula. Karaginski Island in western Kamchatka is also an important molting site (Gerasimov 1972). Band recoveries show that both eastern Russia and Alaska breeding birds come together to molt in southwestern Alaskan estuaries and that there is essentially no interchange between the western Russia and eastern Russia/Alaska breeding populations (Dau 1991). Molt migrants have been observed from mid-August to mid-September in western Alaska (McCaffery and Harwood 1997, C. Dau pers. comm.). Site fidelity of molting Steller's eiders to specific molting areas is high (>95%) based on band recovery data (Flint et al. 1999). C. Dau (pers. comm.) concluded that eiders molting in any specific location likely represent birds from a variety of breeding areas.

Large numbers of Steller's eiders concentrate in Bristol Bay and Alaska Peninsula estuaries during spring and fall migration (Dau 1991b, Larned et al. 1994, Larned and Tiplady 1997). During August and September, males and non- or failed-breeding females congregate in several lagoons on the Alaska Peninsula and undergo a complete molt of their flight feathers. Flint et al. (in press) demonstrated that Steller's eiders exhibit high site fidelity to these molting areas.

Most of the Pacific population of Steller's eider winter in shallow, near-shore marine habitats along the Alaska Peninsula and from the eastern Aleutian Islands to Kodiak Island (Kertell 1991, Dau 1991, Larned and Zwiefelhofer 1995). Fewer Steller's eiders winter in the Gulf of Alaska and from the central Aleutian Islands, the Commander Islands and south along the Pacific coasts where they are uncommon to British Columbia in the west (Roberson 1980) and Japan in the east (Brazil 1991).

Spring surveys along the Alaska Peninsula and southwest Alaska coast in 1992, 1993, 1994, 1997, and 1998 yielded estimates of 137,904, 88,636, 107,589, 90,269, and 102,165 birds, respectively (Larned 1998). These estimates represent the highest number of Steller's eiders seen during any replicate survey within a year, which in turn represents some unknown fraction of the total population. Distribution of Steller's eiders was consistent among years. Important spring staging areas include Izembek NWR, Port Moller, Port Heiden, Ugashik Bay, and Kuskokwim shoals (Fig. 13). Migrational flights are apparently made directly across large bodies of open water such as Bristol Bay. According to Palmer (1976) and Kessel (1989), most Steller's eiders form pair bonds prior to or early during spring migration, and flocks of paired breeding adults migrate first, with juvenile and subadult non-breeders lagging behind.

***Breeding Biology*:** Pairs form on wintering areas of Alaska's North slope in March and April. Pairs leave the wintering grounds together and arrive paired on the breeding grounds. In 1991, Steller's eiders arrived on the breeding grounds near Barrow in early June; pairs were seen in ponds and small streams. Results from the ACP breeding pairs survey suggest that breeding Steller's eiders may arrive on the ACP later than the other species of eider (Larned and Balogh 1997). Steller's eiders appear to be at least seasonally monogamous. Most males abandon hens and leave the breeding area soon after incubation begins.

During the breeding season, Steller's eiders are found primarily in nearshore coastal wetlands, where they nest adjacent to shallow ponds or within drained lake basins (King and Dau 1981, Quakenbush et al. 1995). Ponds with emergent vegetation (*Arctophila fulva*, *Carex aquatilis*) received the highest use by Steller's eiders during the pre-nesting season here, possibly because they provide both feeding habitat and cover. Nesting habitat on the YKD was restricted to the vegetated intertidal zone of the central Delta (King and Dau 1981). Many studies indicate that areas used by Steller's eiders for nesting change over time. These observations indicate that the suitability of an area in a given year may be determined by factors that are ephemeral in nature. Studies in the Barrow area suggest that temporal changes in drainage patterns and the presence and abundance of predators such as jaegars may be important in determining whether an area is used (Quakenbush et al. 1995). In 1991, four of the nests were adjacent to small tundra ponds, and two were located on elevated areas within drained lake basin wetlands. All were within 70 m of permanent water. Of 20 nests found in 1993, all were within 34 m of permanent water.

Nest densities on the North slope ranged from 0-17 nests/km^2 between 1975 and 1980 (Myers and Pitelka 1975). In 1991, a study near Barrow reported a pair density of 1.4 pairs/km^2 in a 12.5 km^2 area (Suydam et al. 1991, Quakenbush and Cochrane 1993). Six nests were found in this plot with little search effort. Four of six nests found had complete clutches by 20 June.

Mean clutch size was 5.8 (n=6) for successful nests. In 1991, nest success was 83% (n=6) and 30.8% (n=13) in 1993. Apparent hatching success was 63% (n=35) for all eggs found and 78.6% (n=28) for eggs found in successful nests (where ≥ 1 egg hatched). In 1993, the rates were 23.2% (n=69) and 88.9% (n=18). Females laid 2- 8 eggs in both years. Known hatch dates ranged from 11-17 July.

Of three nests found on the YKD in 1998, the one that survived was initiated on 10 June (Flint and Herzog, in press). The same hen nested 123 m away from its nest site of the previous year.

Diet: Steller's eiders spend the majority of the year in shallow, near-shore marine waters where they feed by diving and dabbling for bivalve mollusks and amphipods (Petersen 1980, 1981). They are opportunistic and their diet varies according to the availability of prey types at different locations. Mussels and amphipods were the most important foods at Nelson Lagoon during summer (Petersen 1981). Gastropods, clams, and amphipods were the most commonly eaten foods at Izembek Lagoon during winter (Fredrickson, unpubl. data *in* Kertell 1991).

Cottam (1939) collected 66 birds in May, June, and July, from western Alaska and northeast Siberia, and found crustaceans were the dominant food by volume (45.2%); amphipods were the most abundant. Mollusks (19.3%), insects (13.0%), plant material (12.9%), and some miscellaneous items were also present. Insects included those commonly found in freshwater tundra ponds, particularly midge larvae (Chironomidae) and caddisfly larvae (Trichoptera). The proventriculus and gizzard of one female found dead on the North slope was full of chironomid (midge) larvae and a few tipulid (crane fly) larvae (Cottam 1939).

Threats and Mortality Factors: Kertell (1991) mentioned several mortality factors potentially responsible for the demise of Steller's eiders on the YKD, including: 1) increased subsistence harvest due to the combination of more hunters and increased mobility; 2) increased predation as an indirect consequence of the dramatic reduction in size and number of goose nesting colonies, with which eiders nest in close proximity, and the subsequent loss of the "predator swamping" effect that formerly provided protection from predators; and 3) a decline in availability of preferred foods at wintering areas, possibly as a result of competition from expanding sea otter populations.

Flint and Herzog (in press) speculated that, based on the similarity in breeding habitat preferences between Steller's and spectacled eiders, lead poisoning may have been, and may still be, a contributing factor in the decline of Steller's eiders from the YKD.

Flint et al. (in press), using band recovery data, found evidence that survival rates have declined from the late 1970's to early 1990's, and estimated lower survival of males (0.765 ± 0.044 SE) compared to females (0.899 ± 0.032), which may result in a female-biased sex ratio. The factors that influence mortality and that may have caused the trend are unknown, although they suggested that a shortage of drakes may be limiting current reproductive potential. When populations are small, changes in the sex ratio can accelerate population decline (Brown and Gibson 1983).

Steller's eiders were taken in small numbers along the Bering Sea coast, Alaska Peninsula and on Kodiak Island until the season was closed in 1991. Between 1966 and 1991, the federal Parts Collection Survey received Steller's eider wings in 10 of the 32 years, averaging 3 wings per year. Application of wing composition to total duck harvest produced an average harvest estimate of 63 Steller's eiders per year. Average reported subsistence harvest on the YKD from 1987-97 was 31 Steller's eiders (Wentworth 1998).

The magnitude of mortality resulting from birds becoming entrapped in gill nets is unknown.

Scoters - general

Population Status and Trends:

Because scoters are difficult to identify during aerial surveys, the NAWBPS provides a scoter index combining the 3 species present in Alaska. Figure 14 portrays scoter species composition estimated during various surveys in major breeding areas of Alaska. The proportions represent the proportion of all scoters identified to species and does not include unidentified scoters. The reliability of scoter species composition data from aerial surveys is questionable because scoters are difficult to speciate (especially white-winged scoters that do not fly and display their white wing feathers) and because the NAWBPS and Expanded Breeding Pair Surveys are designed to optimize observations of dabblers, not sea ducks, which are often seen during various stages of migration. On the NAWBPS in 1993-97, observers identified scoters to species (seen anywhere within the 200 m transect width) only when they got a good look at them and felt confident in the call. Beginning in 1998, observers identified to species every scoter seen within the closest half of the transect width, and none in the outer half. On Expanded surveys, observers speciated scoters whenever possible but recorded all others as unidentified scoters. Expanded surveys were flown about the same time as, or perhaps slightly later than, the ANWBPS. On Duck Production Surveys in 1990-93, all scoter broods were identified to species, although for most areas, sample sizes are small.

Black scoters predominate in coastal tundra strata, whereas white-winged scoters predominate with lesser numbers of surf scoters in interior boreal forest and southcentral Alaska coastal strata. White-winged and surf scoters made up 75% and 25%, respectively, of birds observed during spring migration on Old Crow Flats. Tundra strata averaged 61% (range 49-73%) and the Old Crow Flats averaged 16% (range 10-27%) of scoters observed annually. Interior strata account for approximately 24% (range 11-40%) of scoter observations annually.

Timing of the NAWBPS hinders accurate monitoring of scoter population trends. Scoters are among the latest waterfowl to migrate during spring. Consequently, the NAWBPS may often occur in areas before arrival of scoters or during migration. This is particularly problematic on the Yukon Flats (King and Haddock 1971, King and Conant 1983), which is probably the most important breeding and migration/staging area for scoters in interior Alaska. The Yukon Flats stratum supports the most scoters in the Interior (Lensink 1965, King and Lensink 1971, Bellrose 1980) but also accounts for the largest fluctuations from year to year due to the early timing of the survey (King and Bartonek 1977, Conant and Roetker 1987).

NAWBPS survey data suggest scoter numbers, although highly variable, show no significant trend (P>0.05) from 1957-1998 (Fig. 15). Trend from 1977-98 suggests a slight steady decline of about 2-3% per year for both interior and tundra strata.

The timing of the NAWBPS on the YKD and other coastal tundra strata, where black scoters predominate, probably captures most breeders although in some climatically late years some migrants en route to coastal habitats may still be present in interior areas (Conant and Roetker 1987, Conant and Dau 1990, Conant and Groves 1992). In the tundra strata, numbers averaged 258,500 in the 1980's and 206,500 from 1990-97. The YKD stratum, where approximately 45-50% of all tundra strata scoters (i.e., black scoters) are counted, suggest a slow, steady decline over the past two decades (Hodges et al. 1996).

ACP breeding pairs survey data indicate a variable and stable population trend for scoters from 1986-98 with an 13-year mean of 12,627 (R. King pers. comm.). Nine years of data (1990-98) on ACP have revealed that of all scoters identified to species: 71.3% were black scoter, 20.0 % white-winged scoter, and 8.7% surf scoter (R. King, pers. comm.). The three species of scoter occurred primarily in the southern portion of the central coastal plain (Brackney and King 1996). The earlier NSE survey is completed prior to the arrival of a large proportion of the population and the ACP breeding pairs survey may provide the best indices of population trend and species composition.

Surveys of nearshore and open water areas of northcentral southeast Alaska in 1980 indicated 131,468 scoters in early August (B. Conant pers. comm.).

There are no estimates of winter population trends for scoters statewide in Alaska. Wintering sea ducks in Alaska and British Columbia are not surveyed on a regular basis, but the numbers counted on limited surveys show that these areas provide important wintering habitat for scoters. Southeast Alaska supports an estimated 176,000 wintering scoters (Conant 1996). Winter aerial surveys of nearshore and open water areas of northcentral southeast Alaska in 1980 provided an estimate of 153,461 scoters (index * VCF of 1.8, as determined by replicate boat surveys versus aerial counts) (Conant et al. 1980, 1988b). The following winter, surveys were confined to northern southeast Alaska with an estimated 92,261 scoters (Conant and King 1981, Conant et al. 1988b). Wintering scoters also occur in nearshore marine habitats of the Aleutian Islands, lower Alaska Peninsula (≥20,000), Kodiak Island (≥70,000), and Gulf of Alaska (Isleib and Kessel 1973, Forsell and Gould 1981, Byrd 1992, C. Dau pers. comm.).

Scoters are among the least studied of North American waterfowl and little is known of their life history, ecology, and distribution. Status and trends of individual scoter species are discussed below.

<u>Black Scoter (*Melanitta nigra*)</u>

***Population Status and Trends:* BELIEVED DECLINING IN WESTERN ALASKA, STABLE ON THE ARCTIC COASTAL PLAIN**

Numbers of scoters declined from 1977-98 at an average annual rate of 2.2% in the tundra stratum of the NAWBPS where black scoter predominate (J. Hodges, pers. comm.) (Fig. 15). The YKD stratum accounts for 45-50% of all tundra strata scoters, and virtually all scoters that breed on the YKD are black scoters. Based on NAWBPS data, scoter numbers appeared to be relatively stable or slightly decreasing during 1989-98 (Fig. 15). Data from the YKD Coastal Zone Survey suggest an increasing black scoter population from 1988-98 (R. Platte, pers comm.)(Fig. 17). Black scoter populations are stable or increasing on the ACP (R. King, pers. comm.) (Fig. 17).

Conant (1996) estimated 176,000 scoters wintered in southeast Alaska in 1996 with the proportion of those identified to species being 79.2% surf scoters and 10.4% each of black and white-winged scoters. Previous estimates of the wintering scoter population for only the north half of southeast Alaska were 63,452 in 1980 and 51,256 in 1981 (Conant et al. 1980, Conant and King 1981). Spring and fall numbers of black scoters in southwest Alaska averaged 14,795 and 22,837, respectively with peaks of 28,430 in spring (1988) and 72,408 in fall (1994)(R. King pers. comm.). Peak numbers of black scoters at Nelson Lagoon on the southern Alaska Peninsula in fall and winter are 17,206 and 12,646, respectively (C. Dau pers. comm.). The Kodiak Archipelago supports a stable to increasing winter population of >32,000 black scoters (Forsell and Gould 1981, D. Zwiefelhofer pers. comm.) with up to 6,500 in eastern and southern areas of Kodiak Island (Larned and Zwiefelhofer 1995). Winter surveys in Prince William Sound have detected few black scoters there, but numbers have been stable since 1990 (B. Lance, pers. comm.) (Fig. 18).

Distribution: The black scoter is a holarctic species (Palmer 1976) (Fig. 16). In North America, breeding may occur east to the Northwest Territories (Bellrose 1980, Bordage and Savard 1995).

Highest densities of scoter (combined species) observed on the NAWBPS in Alaska were in Bristol Bay (3.2 birds/km^2), the YKD (1.8 birds/km^2) and the Seward Peninsula (1.7 birds/km^2), areas where black scoter is the predominant species of breeding scoter (Bellrose 1980, Hodges et al. 1996). Black scoter densities averaged 2.7 birds/km^2 and 7.0 birds/km^2 at two sites along the lower Alaska Peninsula (Dau and Schafer 1996) and 4.3 birds/km^2 at a mid-coastal area of the YKD (B. McCaffery pers. comm.). On the ACP, black scoters comprised an estimated 79% of an average 12,000 scoters each spring from 1986-1998 (R. King, pers. comm.).

Some black scoters arrive at coastal molting sites in western Alaska in late June (Earnst 1986), building to peak numbers in late August and persisting through September (Dau 1987). At least 37,000 scoters molted in nearshore waters of the YKD in 1975, of which about 72% were black scoters (C. Dau, pers. comm.). Because of late nest initiation, some black scoters identified as molt migrants in late June along the west coast of Alaska may still be en route to breeding grounds (Herter et al. 1989). Molting black scoters are also found along the Alaska Peninsula (Gill et al. 1981), and Gulf of Alaska (Islieb and Kessel 1973, Agler and Kendall 1997, however, none was detected in late summer aerial surveys of northern southeast Alaska (B. Conant pers. comm.).

The Alaska wintering population may represent breeding areas from Chukotka to Kamchatka, western and southwestern Alaska and the Kodiak Archipelago and from the east to central Brooks range (Gabrielson and Lincoln 1959, Bellrose 1980, Bordage and Savard 1995). Black scoters traditionally congregate during spring migration at certain areas of coastal southwest Alaska, including Port Moller, Egegik Bay, and Kvichak Bay (Fig. 19)(Larned 1998)

***Breeding Biology*:** Black scoters are believed to breed when 2-3 years old. Courting begins during spring and they arrive paired on the breeding grounds. Black scoters nest along shores of small lakes or ponds; they usually lay 8-9 eggs. Black scoters nest late in coastal western Alaska, frequently delaying nest initiation until early July (Dick and Dick 1971, Bordage and Savard 1995). Black scoters are the latest-nesting waterfowl on the YKD. At Hooper Bay, Alaska, Conover (1926) observed pairs on ponds as late as July 5, but males had apparently left females one week later, a few days before the first broods appeared. In the same area, Dau (1972) found a nest in which the first egg was deposited on June 16. The first brood observation, on July 16 and a recently hatched brood observed on 27 July indicate the span of nest initiation. The black scoter is a late-nesting duck, with a contracted span of nest initiation, and thus does not renest.

Diet: Black scoters feed primarily on aquatic insects in summer and mollusks (especially blue mussels) in winter.

Threats and Mortality Factors: Henny et al. (1995) investigated possible relationships between contaminants and die-offs of molting black scoters in coastal areas of southeast Alaska, west of Yakutat. They found elevated levels of several elements, including cadmium, copper, mercury, iron, and zinc, but could not prove that these contaminants were responsible for the deaths.

Average reported subsistence harvest on the YKD from 1987-97 was 6,051 black scoters (Wentworth 1998). Statewide estimates of subsistence take of black scoters are uncertain because species are often unidentified, although scoters are the second most frequently taken species group in the Alaska subsistence harvest (Wolfe et al. 1990).

White-winged Scoter (*Melanitta fusca*)

Population Status and Trends: **POSSIBLY DECLINING**

Based on NAWBPS data, scoter numbers have declined in the interior, boreal forest habitats, in Alaska (Fig. 15). There is no quantitative assessment of species composition for scoters breeding in interior Alaska. Lensink (1965), however, reported that white-winged scoters were more abundant than surf scoters. Timing of the survey in relation to phenology of climate and migration causes substantial annual variation in numbers. Consequently, an assessment of white-winged scoter population trend is difficult. Scoter numbers have remained stable over 21 years on Old Crow Flats, NWT where, like in interior Alaska, white-winged scoters outnumber surf scoters (Irving 1960).

Winter surveys in Prince William Sound suggest an increasing wintering population of white-winged scoters there (B. Lance, pers. comm.)(Fig. 18). The Kodiak Archipelago supports a stable to decreasing winter population of >35,000 white-winged scoters (Forsell and Gould 1981, D. Zwiefelhofer pers. comm.) with <1,000 wintering in eastern and southern areas of the Archipelago (Larned and Zwiefelhofer 1995).

Distribution: White-winged scoters have a circumboreal distribution (Fig. 16). In Alaska, the highest densities of scoters observed on the NAWBPS in interior boreal forest habitats, where white-winged and surf scoters predominate, were on the Yukon Flats (1.6 birds/km^2), the Tanana-Kuskokwim (1.0 birds/km^2) drainage, and the Nelchina Basin (0.9 birds/km^2)(Hodges et al. 1996). The proportion of white-winged scoters to surf has not been determined for these areas, however, white-winged scoters predominate while black scoters are uncommon (Bellrose 1980). On the ACP, white-winged scoters are uncommon, comprising an estimated 18% of an average 12,627 scoter observations each spring from 1986-1998 (R. King, pers. comm.). White-winged scoter densities averaged 0.2 birds/km^2 and 1.4 birds/km^2 at two sites along the Alaska Peninsula (Dau and Schafer 1996).

Gabrielson and Lincoln (1959) noted difficulty in detecting the northward migration of scoters in southeast Alaska because of the large numbers of nonbreeders that, along with molt migrants, occur in the area. Elsewhere in their range molt migrations and other movements are poorly understood. Males abandon their mates in early July after the beginning of incubation and move to coastal areas to molt (Bellrose 1980). An estimated 51,200 white-winged scoters, 77% of the total observed, made a molt migration past Cape Peirce (Herter et al. 1989). Likely molting sites for birds passing Cape Peirce are in western Alaska (black and surf scoters) or eastern Siberia (white-winged scoters)(Gerasimov 1972). White-winged scoters made up 9.6% of the 131,468 scoters summering in northern southeast Alaska (Bruce Conant pers. comm.) and <1% of an estimated peak of 36,500 molting scoters summering off the Yukon-Kuskokwim Delta (Dau 1987). Molting white-winged scoters are also found along the Alaska Peninsula (Gill et al. 1981, Bailey and Faust 1981) and Gulf of Alaska (Islieb and Kessel 1973, Agler and Kendall 1997).

Most of the Pacific population of white-winged scoters winter from southeast Alaska to California (Palmer 1976). Conant et al. (1996) estimated 176,000 scoters wintered in southeast Alaska in 1996. Of those identified to species, 79.2% were surf scoters and 10.4% each were black and white-winged scoters. Thousands of white-winged scoters from undetermined breeding locations winter from eastern Kamchatka to Japan (Kistchinski 1973). The southward spring migration of up to 10,000 birds in western Alaska in mid-May (B. McCaffery, pers. comm.) suggests the possibility of asiatic wintering birds following eastern and northern migration routes to Alaska breeding locations. Spring and fall numbers of white-winged scoters in southwest Alaska average 361 and 1,210, respectively with peaks of 1,077 in spring and 8,401 in fall (R. King, pers. comm.). Important spring staging areas in western coastal Alaska include Port Moller, Ugashik Bay, Egegik Bay, and Etolin Strait (Fig. 20). Peak fall number of white-winged scoters at Nelson Lagoon on the southern Alaska Peninsula was 2,156 with fewer than 50 birds seen in winter (C. Dau, pers. comm.).

***Breeding Biology*:** White-winged scoters are one of the last ducks to reach the breeding ground and one of the last to nest (Bellrose 1980). They begin to breed when 2-3 years old. Pairing occurs on the wintering grounds, and migrating flocks in spring consist of paired birds. Male white-winged scoters remain with their mates until the first week of incubation. In Alberta, few males were observed after 1 July. Vermeer (1968) determined that nests in Alberta were initiated between 6 June and 3 July; a span of 27 days. Brown found that 69 nests were initiated between 8 and 22 June, with the average date of 15 June. White-winged scoter nests are extremely difficult to locate and may be placed a considerable distance from the water. Most nest in dense cover. According to Brown and Brown (1981), mean laying rate for 8 females was one egg every 34.4 hours; mean clutch size was 9.17, and incubation period was 25-31 days (average= 28 days).

The late breeding season combined with the short span of nest initiation precludes any significant degree of renesting. Broods of white-winged scoters often form creches of up to 100 ducklings with one or more female attendant. King (1963) reported that white-winged scoter broods in Alaska often amalgamate within a day or two of hatching to form a creches of up to 100 ducklings with one female attendant; flocks of 2 or more broods were found only on very large lakes. Hochbaum (1944) estimated a fledging period of 63-77 days.

Diet: White-winged scoters are chiefly bottom feeders, eating mollusks, crustaceans, and insects. White-winged scoters foraged in Kachemak Bay, Alaska, in waters <20 m deep over bottoms of shell debris and cobble (Sanger et al. 1982). The most important foods eaten were common Pacific littleneck clam (*Protothaca staminea*), blue mussel, and puppet margarite snail (*Margarites pupillus*). Most studies consider the white-winged scoter an opportunistic feeder that concentrates on bivalves and snails (Vermeer and Bourne 1981, Sanger et al. 1982).

Threats and Mortality Factors: Henny et al. (1995) investigated possible relationships between contaminants and die-offs of molting white-winged scoters in coastal areas of southeast Alaska, west of Yakutat. They found elevated levels of several elements, including cadmium, copper, mercury, iron, and zinc in tissues of molting scoters, and also found elevated levels of selenium in livers of breeding white-winged scoters on Yukon Flats NWR. However, they could not prove that these contaminants were responsible for the deaths.

Average reported subsistence harvest on the YKD from 1987-97 was 2,434 white-winged scoters (Wentworth 1998). Statewide estimates of subsistence take of white-winged scoters are uncertain because species are often unidentified, although scoters are the second most frequently taken species group in the Alaska subsistence harvest (Wolfe et al. 1990).

Surf Scoter (*Melanitta perscipillata*)

Population Status and Trends: **POSSIBLY DECLINING**

Based on NAWBPS data, scoter numbers have apparently declined in interior boreal forest habitats in Alaska (Fig. 15). There is no quantitative assessment of species composition for scoters breeding in interior Alaska. Lensink (1965) reported that white-winged scoters were more abundant than surf scoters. Timing of the survey in relation to phenology of climate and migration causes substantial annual variation in numbers. Consequently, surf scoter population trend is difficult to assess. Scoter numbers have remained stable on Old Crow Flats, NWT where white-winged scoters also outnumber surf scoters (Irving 1960).

Winter surveys in Prince William Sound suggest an increasing wintering population of surf scoters there (B. Lance, pers. comm.)(Fig. 20). The Kodiak Archipelago supports a stable winter population of over 5,000 surf scoters (Forsell and Gould 1981, D. Zwiefelhofer pers. comm.) with <1,000 wintering in eastern and southern areas of Kodiak Island (Larned and Zwiefelhofer 1995).

Distribution: The surf scoter is a nearctic species that breeds in boreal forests of Alaska and northern Canada east to Hudson Bay, Quebec and Labrador (Bellrose 1980) (Fig. 16). The highest densities of scoters (combined species) observed on the NAWBPS in interior Alaska taiga habitats, where surf and white-winged scoters predominate, were found on the Yukon Flats (1.6 birds/km^2), the Tanana-Kuskokwim (1.0 birds/km^2) and the Nelchina Basin (0.9 birds/km^2) (Hodges et al. 1996). The proportion of surf to white-winged scoters has not been determined for these areas. White-winged scoters appear to predominate whereas surf scoters are uncommon. On the ACP, surf scoters are uncommon, comprising an estimated 3% of an average 12,000 scoter observations each spring from 1986-1998 (King and Brackney 1997).

The molt migration and other movements of surf scoters in Alaska are poorly understood. Most males abandon their mates early in incubation and move to coastal areas or large lakes to molt by mid-June (Bordage and Savard 1995). Bruce Conant (pers. comm.) estimated 131,468 (not known if this is adjusted for detection) scoters summered in southeast Alaska in 1996. Of those identified to species, 90.4% were surf scoters. Surf scoters made up 12% of 66,500 molt-migrating scoters at Cape Peirce (Herter et al. 1989) and 27% of an estimated peak of 36,500 molting scoters summering off the YKD (C. Dau, pers comm.). Molting surf scoters are also found in lagoons along the ACP (R. King pers. comm.), the Alaska Peninsula (Gill et al. 1981), and in the Gulf of Alaska (Islieb and Kessel 1973, Agler and Kendall 1997).

Satellite transmitters were implanted in 4 surf scoters (1 female and 3 unpaired males) in Prince William Sound in 1998. The female bred in Northwest Territories in the Horton River drainage and died there of unknown cause. All 3 males moved straight from wintering areas in PWS to Kuskokwim Shoals area to molt, then dispersed back to wintering areas in Prince William Sound, Lower Cook Inlet, and near Sitka (D. Rosenberg, pers. comm.).

Surf scoters winter on the Pacific and Atlantic coasts of North America rarely south of northern Baja California and the Carolinas (Palmer 1976). On the Pacific coast, most surf scoters winter from southeastern Alaska to Washington.

Spring and fall numbers of surf scoters in southwest Alaska averaged 210 and 653, respectively, with peaks of 785 in spring (1985) and 3,582 in fall (1990)(R. King, pers. comm.). Peak number of surf scoters at Nelson Lagoon on the southern Alaska Peninsula in fall was 734 with <20 birds seen in winter (C. Dau pers. comm.). Surf scoters are most numerous in Prince William Sound during spring due to the large influx of migrants that feast on spawning Pacific herring (*Clupea pallasi*) (Isleib and Kessel 1973, Bishop et al. 1995). Up to 30,000 surf scoters have been estimated during March surveys in Prince William Sound (B. Lance, pers. comm.).

Most of the Pacific population of surf scoters winter from southeast Alaska to California (Palmer 1976). Conant (1996) estimated 176,000 scoters wintered in southeast Alaska in 1996 with the proportion of those identified to species being 79.2% surf scoters and 10.4% each of black and white-winged scoters. Agler et al. (1995) estimated about 221,000 surf scoters in southeast Alaska in March 1994.

***Breeding Biology*:** Very little is known about the breeding habits and other life history activities of the surf scoter, and relationships among breeding, molting, and wintering sites are not clear. Surf scoters breed on small freshwater ponds. They first breed when 2-3 years old, and clutch size is 5-8 eggs. Range of nest initiation dates in the Northwest Territories was 19 June to 8 July, with half of those between 25 June and 1 July (MacFarlane 1891 in Bent 1925).

Diet: In winter, surf scoters feed in intertidal and subtidal areas. They feed primarily on bivalves, particularly blue mussels, but may switch to herring roe during spring. Cottam (1939) reported that 88% of the contents of 168 gizzards from adult surf scoters was composed of animal life and 12% of plant food. Mollusks made up 61% of the animal foods, blue mussels being the most important. Crustaceans, principally barnacles and crabs made up 10% of the contents; aquatic insects (caddisflies, dragonflies, damselflies, diving beetles) also formed 10% of all food items. Pondweeds, eelgrass, and widgeon grass were the principle plants consumed. Scott and Olson (in Bellrose 1980) observed selection of sandy substrates with clams as preferred feeding areas by all three scoter species.

Threats and Mortality Factors: In winter, surf scoters feed in intertidal areas that are susceptible to contamination, including oil spills. They feed primarily on blue mussels, which are known to concentrate contaminants. Estuarine development, introductions of exotic species, or other human activities can potentially harm scoters.

Henny et al. (1995) investigated possible relationships between contaminants and die-offs of molting scoters, including some surf scoters, in coastal areas of southeast Alaska west of Yakutat. They found elevated levels of several elements, including cadmium, copper, mercury, iron, and zinc, but could not prove that these contaminants were responsible for the deaths. Surf scoters wintering in Oregon and Washington in 1984-85 had elevated concentrations of cadmium; body weights were correlated with cadmium concentrations (Henny et al. 1991). Identifying sources of contamination is difficult because of the lack of information on breeding, molting, or wintering areas of these birds.

Average reported subsistence harvest on the YKD from 1987-97 was 697 surf scoters (Wentworth 1998). Statewide estimates of subsistence take of surf scoters are uncertain because species are often unidentified, although scoters are the second most frequently reported species group in the Alaska subsistence harvest (Wolfe et al. 1990).

<u>Harlequin Duck (*Histrionicus histrionicus*)</u>

Population Status and Trends: **PROBABLY STABLE**

Very little population information is available but in most areas the western population is stable or showing slight declines in number and distribution (Goudie et al. 1994). Limited information range-wide and possible declines in some areas in Alaska warrant increased efforts to monitor this population.

The NAWBPS does not adequately sample habitats used by harlequin ducks so there is no historic aerial survey index of population trend for breeding harlequin ducks in Alaska. Limited surveys suggest a stable wintering population in southeast Alaska (Conant et al. 1980, Conant and King 1981, Conant 1996). Harlequin ducks are common and broadly distributed in mountainous areas of southwest Alaska; numbers of harlequins increased from 1994-98 on the Kisaralik River and the area-wide population is variable but seems stable (McCaffery et al. 1998). Surveys over the past two decades in the Kodiak Archipelago indicate a stable to increasing population (Forsell and Gould 1981, Zwiefelhofer 1998).

The Exxon Valdez oil spill reduced the population of harlequin ducks in Prince William Sound (Patten 1998) and recent studies suggest population recovery has not occurred in oiled areas (D. Esler pers. comm., Rosenberg and Petrula 1998). Up to 18,000 harlequins have been estimated wintering in Prince William Sound, and winter surveys suggest an increasing population Sound-wide from 1990-98 (Fig. 21).

There are no estimates of winter population trends for harlequin ducks statewide in Alaska. An estimated 100,000-147,000 harlequin ducks winter in the Aleutian Islands with limited trend data suggesting a stable population (Byrd 1992, Byrd et al. 1992). Southeast Alaska supports an estimated 54,600 wintering harlequins (Conant 1996). Population estimates (over 44,000) and densities (1.24 harlequins/ shoreline kilometer) were made from boat surveys of southeast Alaska in the summer of 1994 (Agler et al. 1995).

Distribution: The harlequin duck is a holarctic but discontinuous breeder with apparently distinct Pacific and Atlantic breeding and wintering populations (Bellrose 1980, Palmer 1976) (Fig. 22). The western population, most abundant in Alaska and British Columbia has been estimated to number from 200,000-300,000 birds (Goudie et al. 1994) whereas the eastern population, numbering only about 2,000, was declared endangered in Canada in 1991 (USFWS et al. 1997). Winter surveys of the eastern population suggest declines may have stopped and possibly reversed at some sites (USFWS et al. 1997).

Breeding harlequin ducks are widely distributed in Alaska from the Brooks Range south to the Alaska Peninsula, Kodiak Island and southeast Alaska, nesting near clearwater fluvial areas (Gabrielson and Lincoln 1959). Most of the Alaska population breeds south of the north slope of the Brooks Range (Johnson and Herter 1989). Harlequin ducks breed in small numbers along mountainous drainages from the Yukon Territories and British Columbia south to Wyoming and central California. A smaller portion of the Pacific wintering population breeds in the Far East from southern Chukotka and Kamchatka to Lake Baikal and Sakhalin Island south to northern

Honshu and winters from southern Kamchatka and the Commander Islands south to central Honshu.

Harlequin ducks are inextricably linked to nearshore marine environments, spending most of their annual cycle along rocky coasts, headlands, or cobble beaches. Marine areas support the entire population during wing molt and winter and many nonbreeding birds during summer. Adults leave coastal areas only for a few summer months, when they migrate to fast-moving streams to breed. Seasonal variation in abundance and population composition has been described for harlequin ducks in Prince William Sound, Alaska (Rosenberg and Petrula 1998). A growing body of data suggests that harlequin ducks exhibit a general pattern of high philopatry throughout their annual cycle (D. Esler, pers. comm.). Molt site philopatry of harlequin ducks in Prince William Sound was high; 96.7% of ducks recaptured between years were found at the same or adjacent sites as their previous capture (D. Esler, pers. comm.). Similarly, 92% of radio-tagged adult females moved <20 km during wing molt and winter.

In Alaska the centers of abundance of summering harlequins, including an unknown proportion of breeding birds, are southwest Alaska, the Alaska Peninsula and Aleutian Islands, Prince William Sound and southeast Alaska. Numbers of summering harlequins in these areas, although not well known, are estimated at several thousand along the south side of the Alaska Peninsula (Bailey 1978, Bailey and Faust 1981, R. Clark, pers. comm.), 15,000 in the Aleutian Islands (Byrd et al. 1992), more than 11,000 in the Kodiak Archipelago (Zwiefelhofer 1998), and 44,000 (±43%)(1995: B. Agler, pers. comm.) in southeast Alaska. Compared to the size of the wintering population, relatively few (about 5,000) harlequin ducks remain in Prince William Sound to nest (Rosenberg and Petrula 1998). Low volume, high gradient coastal streams characteristic of PWS are not considered ideal breeding habitat for harlequin ducks (Crowley 1994) and is probably why few harlequin broods are observed coastally there (Rosenberg and Petrula 1998).

The center of winter abundance of the Pacific population is the Aleutian Islands (in excess of 100,000) however they are also common from the Alaska Peninsula (in exess of 6,000) and the Kodiak Archipelago (in excess of 11,000) to southeast Alaska (in exess of 18,000)(Islieb and Kessel 1973, Conant et al. 1980, Conant and King 1981, Byrd 1992, Conant et al. 1988, 1996, Boden 1994, Larned and Zwiefelhofer 1995, Zwiefelhofer 1997a).

Harlequin ducks traditionally congregate during spring migration at certain areas of coastal southwest Alaska, including Izembek Lagoon (Fig. 23)(Larned 1998).

***Breeding Biology*:** Harlequin ducks are not known to breed until at least their second year. Most adults are paired by the time they leave the sea early in May for their interior breeding grounds. Prior to the breeding season in early May, males comprise approximately 60% of the harlequin population in Prince William Sound, while up to 70% of the total population may be paired at this time (Rosenberg and Petrula 1998). Early in incubation, males abandon their mates and leave the breeding areas. Harlequin ducks usually nest along rocky shores or on islands in rapid mountain streams. Eggs are laid at intervals of 2-4 days (Bengtson 1966). Clutch size is 3-8 eggs and incubation period is about 28-29 days. In Alaska, laying begins between 15 May and 30 May. On mountainous rivers on the YKD, Harwood and McCaffery (1996) recorded the first harlequin pair arriving on 7 May. Courtship was observed from 7 May - 2 June and peak numbers of birds occurred 26-28 May. Timing of departure by pairs to breeding areas in the spring, and the return of post-breeding males to the coast in early summer, can vary annually indicating annual variation exists in breeding chronology (Rosenberg and Petrula 1998). The proportion of females attempting to nest, as well as nest success, varies widely between years. Females may move broods to marine areas if close by, or remain in the same areas during brood-rearing. Fidelity to nest sites is apparently high (Bengtson 1966). Males desert their mates early in the incubation period and molt elsewhere, usually in coastal marine areas.

One of the only studies of coastal breeding harlequin ducks in North America was conducted in Prince William Sound after the Exxon Valdez oil spill (Crowley 1994, Crowley and Patten 1996). During 1991 and 1992, 65 harlequin ducks (48 females) were captured and banded on 10 coastal streams. Harlequin ducks breeding in eastern PWS exhibited higher breeding propensity than inland-breeding populations. Twelve of 15 and 20 of 27 adult female harlequin ducks captured at stream mouths in PWS were breeding birds in 1991 and 1992, respectively, averaging 80% return rate. Harlequin ducks breeding along coastal streams in Prince William Sound forage opportunistically on abundant resources of intertidal deltas and salmon spawning beds during summer. In contrast, inland-breeding harlequin ducks rely entirely on lotic invertebrates, a shortage of which may reduce breeding propensity (proportion of adult females breeding) during some seasons.

Ten nests were located in PWS by following radio-marked females. Nest initiations, calculated by back-dating from seven nests and 40 broods of known age class (1991–1992 combined), occurred from 15 May through 18 June, with 45 of 47 occurring by 15 June. Average number of eggs in seven clutches of known size was 6.13 ± 0.92 (SD). There were too few nests to reliably estimate nest success, but at least five of seven nests produced hatchlings, and known hatching success for 32 eggs in five nests was 97.2%.

Sixty broods were observed during five years of surveys in PWS (Crowley 1994, Crowley and Patten 1996). The observed cumulative mortality of ducklings from age class 1a to fledging was approximately 57%. This was likely an underestimation of mortality, because loss of entire broods was not detectable using this method. Unusually high mortality of ducklings, relative to studies of other populations, occurred from three to five weeks of age. Average brood size at fledging age was 2.4 ± 0.82 young. Despite the higher breeding propensity observed in eastern PWS, preliminary estimates of recruitment suggest that coastal-breeding harlequin ducks have lower productivity than inland-breeding populations.

Diet: In mountain streams during the breeding season, harlequins dive to 2 to 3 feet in swift currents in their search for food, chiefly aquatic insects and crustaceans. In marine areas, harlequin ducks typically forage <50 m from shore over cobble to cobble/rock substrate of gradual gradient, and over sand substrate of gradual gradient containing eelgrass or kelp. Diets of harlequin ducks in marine areas consist largely of intertidal and shallow subtidal benthic invertebrates, including amphipods, limpets, snails, chitons, and mussels (Vermeer 1983, Goudie and Ankney 1986, Gaines and Fitzner 1987, Goudie and Ryan 1991, Patten et al. 1998), and fish roe when available (Dzinbal and Jarvis 1982). Fischer (1998) found that gastropods (primarily *Littorina sitkana*), crustaceans (predominantly gammerid amphipods) and insect larvae (dipteran larvae and pupae) made up the majority of the winter diet in the Aleutian Islands.

Threats and Mortality Factors: An estimated 1,300 harlequin ducks died as a direct result of the *Exxon Valdez* oil spill. Evidence for lack of recovery since the spill include: 1) lower harlequin densities in oiled areas (T. Bowman, pers. comm.), 2) divergent trends in population size between oiled and unoiled areas, with increasing trends in unoiled areas and stable or decreasing trend in oiled areas (Agler and Kendall 1997, Rosenberg and Petrula 1998), 3) lower survival of radio-tagged female harlequins in oiled areas than in unoiled areas during winter, and 4) evidence of continuing hydrocarbon exposure in tissues (D. Esler, pers. comm.). Given high levels of site fidelity, the ability of local populations to recover from an oil spill can be depressed because of their reliance solely on recruitment for population growth (i.e., absence of immigration) and because of potential cumulative effects on birds in oiled areas, if deleterious effects still exist.

Average reported subsistence harvest on the YKD from 1987-97 was 196 harlequin ducks (Wentworth 1998). Statewide estimates of subsistence take of harlequin ducks are uncertain because species are often unidentified, although harlequins are a minor species in the Alaska subsistence harvest. Paige and Wolfe (1997) estimated about 2,400 harlequins are taken annually for subsistence purposes. Estimate sport harvest, based on a very small number of wings sampled by the federal Parts Collection Survey, was about 500 harlequins (Table 4).

Oldsquaw (*Clangula hyemalis*)

Population Status and Trends: **LONG-TERM DECLINE IN WESTERN ALASKA, STABLE ON ARCTIC COASTAL PLAIN**

The NAWBPS indicates declines of about 5.5% per year in surveyed areas of Alaska since 1977 (B. Conant pers. comm.). The rate of decline appears to have decreased over the last 10 years, 1989-98 (Fig. 24). Aerial breeding pair surveys show relatively stable numbers on the ACP (R. King, pers. comm.) since 1986 (Fig. 25), and slowly increasing numbers on the coastal YKD since 1988 (Platte et al. 1998)(Fig. 25). The NSE survey is flown before most oldsquaw arrive on the ACP, consequently estimates of abundance from that survey should not be used to assess population status. It is unknown whether populations on the ACP experienced a decline prior to 1986 similar to that observed on the YKD (based on NAWBPS data).

Curiously, the NAWBPS and YKD Coastal Zone Survey suggest conflicting trends for oldsquaw on the YKD. For 1988-98, the NAWBPS indicates a significant decreasing trend, whereas the YKD Coastal Zone Survey indicates a significant increase in population size (the NAWBPS is more extensive and represents a larger population, but it is also less intensive and therefore less precise than the YKD Coastal Zone Survey).

There are few records of breeding oldsquaw for interior Alaska and most birds observed in interior strata of the NAWBPS are considered to be late migrants or nonbreeding birds (King and Lensink 1971). Wide variations in population size may be due to migrating birds counted in interior strata (Conant and King 1981). Spring breakup conditions can cause migrants to linger in the interior when they are delayed in their northern flight (King and Bartonek 1977, King and Conant 1983), resulting in high numbers, or conditions can delay migrants altogether, resulting in very low numbers (Conant and Dau 1990). Regardless of variation, the apparent decline in interior Alaska is marked.

There are few estimates of winter population size or trend for oldsquaw statewide in Alaska. Southeast Alaska supports an estimated 163,000 wintering oldsquaw (Conant 1996). Boat surveys suggest an increasing wintering population in Prince William Sound from 1990-98 (B. Lance, pers. comm.)(Fig. 24).

Distribution: The oldsquaw is probably the most numerous and most widely distributed duck in the arctic and subarctic (Bellrose 1980)(Fig. 26). It is circumpolar in distribution and is a common breeder in Greenland, Iceland, Norway, Sweden, Finland, and across the Russian coastline of the Arctic Ocean to the Bering Sea and the Canadian Arctic from the Yukon Territory to Labrador (Palmer 1976). Principal nesting areas in Alaska include the ACP, YKD, Bristol Bay, Seward Peninsula, and Kotzebue Sound (King and Lensink 1971, King and Brackney 1997) (Fig. 26). The highest density of oldsquaws recorded on the Alaska-Yukon portion of the NAWBPS is found on the Seward Peninsula, where an average of 1.8 birds per square kilometer have been counted (Hodges et al. 1996), although higher densities occur on the ACP (R. King, pers. comm.). Breeding oldsquaw are found only at low densities in interior Alaska and along the Alaska Peninsula.

At least 250,000 and possibly as many as one million oldsquaw migrate into the Beaufort Sea area each May and June. The bulk of the oldsquaw population nesting in the western arctic of North America passes through the Beaufort region (Wilbor 1999). Although most follow coastal and offshore migration routes, a large number also fly through interior Alaska and over the Brooks Range (Johnson and Richardson 1981, Johnson and Herter 1989). At Barrow, arriving oldsquaws were observed from 9 May (Johnson 1971) to 16 May (Woodby and Divoky 1982) with peaks between the last week in May and the second week in June.

During July and August, an estimated “tens of thousands” of postbreeding males and nonbreeders of both sexes congregate to molt on large inland thaw lakes and protected Beaufort Sea lagoons (Bergman et al. 1977, Johnson and Richardson 1981, Johnson 1985, Taylor 1986). Historically, large numbers of oldsquaw molted at Takslesluk Lake on the YKD (King 1973) although, for unknown reasons, these large concentrations of molting oldsquaw are now absent on the YKD. Recent radio telemetry data suggest that oldsquaw that breed on the YKD either migrate to St. Lawrence Island or remain on the YKD to molt (P. Flint, pers. comm.).

The extent of the winter range of the oldsquaw is known, but the distribution of specific breeding or molting populations is unknown due to the lack of marking or banding data. The Pacific population of oldsquaw winters in the northern Bering Sea, the large polynya associated with St. Lawrence, St. Matthew and Nunivak islands, and along the Alaska coast from the Aleutian Islands to southeast Alaska (McRoy et al. 1971, Kistchinski 1973, Divoky 1979, Bellrose 1980, Everett et al. 1989, Petersen et al. 1995). Smaller numbers winter along the coasts of British Columbia, Washington, Oregon, and California (Bellrose 1980). In far eastern Asia, oldsquaws winter along the coast of Kamchatka and the Sea of Okhotsk south to northern Honshu (Kistchinski 1973, Brazil 1991). Up to 65,000 oldsquaw were estimated to winter in the Kodiak Archipelago (Forsell and Gould 1981) with current estimates in excess of 50,000 birds (D. Zwiefelhofer pers. comm.). Conant (1996) estimated 163,000 oldsquaw wintered in southeast Alaska in 1996. Spring and fall numbers of oldsquaw in southwest Alaska from 1980-1996, average 2,296 and 189, respectively with peaks of 8,218 in spring and 1,899 in fall (R. King pers. comm.). Oldsquaw at Nelson Lagoon on the southern Alaska Peninsula in fall and winter, number fewer than 500 and 10,330, respectively (C. Dau pers. comm.). Oldsquaw traditionally congregate during spring migration at certain areas of coastal southwest Alaska (Fig. 27)(Larned 1998).

Oldsquaws banded as molting birds on the YKD have been recovered mostly in northeast Russia or in western Alaska (Wilbor 1999) (Fig. 28). Wilbor (1999) summarized band recovery data and concluded that the main winter range for the western Alaska and eastern Russia populations of oldsquaw is likely the Sea of Okhotsk-western Bering Sea, from southern Kamchatka Peninsula to the area of southern Sakhalin Island and northern Hokkaido Island. Band recovery data has not provided much insight into breeding areas or migration routes of oldsquaw that winter along the Alaska coast from the Alaska Peninsula to southeast Alaska (Wilbor 1999). Female and male oldsquaw exhibit some degree of site fidelity to molting areas on the YKD.

***Breeding Biology*:** Most oldsquaw probably do not breed until they are at least two years old (Manning et al. 1956, Palmer 1976). Pair bonds in oldsquaw are established in winter or during spring migration; most arrive on breeding grounds in pairs. Oldsquaws show high philopatry to breeding sites (Salomonsen 1950-51, Alison 1972). Females select nest sites, which are commonly placed on islands, either offshore along the coast, or inland in tundra ponds and lakes. On the arctic coastal plain, nest sites are characteristically found on small discreet wetlands with a combination of emergent vegetation (*Arctophila* or *Carex*) for cover from predators, and an open deep water central zone to allow for diving for intertebrate prey (Wilbor 1999). Most nests are located close to water's edge, but may be located in nearby upland habitat. Nests are placed in natural depressions or on former nest sites. Oldsquaw have also been found nesting on rocky sites in the high arctic.

Clutch size averages 7.3 eggs and incubation period is 26 days, with a range of 24 to 29 days (Alison 1972). Estimated dates of nest initiation in Alaska, as determined by the occurrence of downy young, are 6 June, Nunivak Island; 13 July, Pribalof Islands; 25 June, Point Barrow; 10 June. Oldsquaws fledge at about 35 days. Male oldsquaw leave tundra nesting grounds in late June or early July.

Diet: Oldsquaw eat a variety of aquatic animal foods. Midge larvae accounted for 97% of the diet of breeding birds upon arrival on the ACP (Taylor 1986). In mid-summer, their diet was composed of 29% Daphnidae, 28% Chironimidae, 20% Anostraca, 6% Chironimidae pupae, 6% Chironimidae adult, and 3% Plecoptera nymphs.

Those molting in the Beaufort Sea off the ACP primarily ate two species of mysids (*Mysis relicta* and *M. litoralis*, 70% by volume) and one amphipod (*Onisimus glacialis*, 15%). The remainder of the diet was mostly bivalves (Johnson 1982). Oldsquaws fed primarily in the portions of the lagoon that ranged from 2-3 m in depth, where prey densities were highest. Brackney and Platte (1987) found that oldsquaws molting in Nunagapak Lagoon ate amphipods (30%), gastropods (17%), mysids (13%), pelecypods (7%), isopods (7%), Cumaceans (7%), and unidentified animal matter (17%).

Most important foods during winter in Kachemak Bay, Alaska were Pacific Sandlance (*Ammodytes hexapterus*), Stimpson's surf clam (*Spisula polynyma*), and blue mussel (*Mytilus edulis*) (Sanger and Jones 1982). Birds foraged in waters <20 m, mostly over substrates of sand and mud. Hirsch (1980) analyzed stomach contents of 19 oldsquaw collected in the Strait of Juan de Fuca, Washington; based on total volume, crustaceans comprised 34%, gastropods 31%, bivalves 12%, unidentified animal matter 11%, roe 9%, and Polychaeta 2%. Vermeer and Levings (1977) described a diet comprised, by weight, of 58% bivalve, 33% crustaceans, and 8% gastropods.

Threats and Mortality Factors: Oldsquaw are preyed upon by arctic fox, red fox, bald eagles, gyrfalcons, peregrine falcons, and snowy owls. Eggs and young may be taken by jaegers, gulls, ravens, and foxes.

Exposure to lead shot has been documented on the YKD; about 21% of nesting female oldsquaw in an area along the lower Kashunuk River were exposed to lead at hatch (Flint et al. 1997). However, given the wide distribution of oldsquaw and the localized nature of hunting pressure, it is unlikely that lead poisoning is reponsible for population-wide declines. Lead shot has been used almost exclusively on the YKD, and regulations requiring the use of nontoxic shot have been enforced since 1998. There is evidence of some lead shot exposure on the ACP, but it is not well quantified (E. Taylor, pers. comm.).

Oldsquaw may be threatened by heavy metal contamination as a result of eating benthic organisms. In Quebec, oldsquaw had the highest heavy metal burden of all sea ducks sampled. However, deleterious effects of these contaminants have not been demonstrated. Oil spills are also a threat to this species, which spends so much time at sea. The magnitude of mortality from entanglement in fishing nets is largely unknown.

Paige and Wolfe (1999) estimated that about 18% of an estimated 57,529 (i.e., about 10,000) sea ducks harvested for subsistence in Alaska were oldsquaw, with highest harvests on the YKD and Upper Yukon/Koyukuk/Tanana regions. Average reported subsistence harvest on the YKD from 1987-97 was 2,248 oldsquaw (Wentworth 1998). Additionally, an average of 117 eggs were taken annually on the YKD from 1987-97 (Wentworth 1998). Fay (1961) reported that Eskimos on St. Lawrence Island may take more than 1,000 oldsquaw during winter months.

Average annual sport harvest of oldsquaw in Alaska, based on a very small number of wings sampled by the federal Parts Collection Survey, is about 300 birds (Bartonek 1993, Table 4), although species-specific estimates of sea duck sport harvest are generally unreliable (T. Rothe, pers. comm.). In Russia, oldsquaws are taken by commercial hunters, but no quantitative information is available.

Greater and Lesser Scaup (*Aythya marila and Aythya affinis*)

Population Status and Trends: **STABLE OR INCREASING IN TUNDRA STRATA (MOSTLY GREATERS); SLOW DECLINE IN INTERIOR STRATA (MOSTLY LESSERS)**

Greater scaup populations in North America have been declining for at least 40 years (Barclay et al. 1995, Serie 1996). In Alaska, NAWBPS data for scaup were analyzed separately for "interior" and "tundra". Greater scaup are believed to make up essentially all "tundra" aerial observations based on ground studies by numerous observers whereas lesser scaup predominate in "interior" areas. Data indicate a variable tundra scaup population that has increased overall since the 1960s (Fig. 29). Data for the last 10 years, 1989-98 indicate an increasing population. Similarly, observations during the YKD Coastal Zone Survey indicate a stable to increasing greater scaup population (Platte et al. 1998)(Fig. 30). Greater scaup populations are stable on the ACP (King and Brackney 1997)(Fig. 30). Interior scaup populations, comprised mostly of lesser scaup, are highly variable but suggest a long term decline of about 1-2% per year since the early 1960s. Knowledge about the proportion of greater versus lesser scaup in surveyed strata is poor and there is some concern that proportions of lesser and greater scaup have shifted in some areas, thereby confounding conclusions about population trends based on tundra versus interior strata (Austin et al. 1999). Macluskie et al. (unpubl. data, in Austin et al. 1999) analysed NAWBPS data intensively and determined that declines of scaup were widespread in the western Canadian boreal forest, but the cause(s) of the decline in this region does not appear to be affecting populations in interior Alaska.

There are no estimates of winter population trends for greater scaup statewide in Alaska, and band recovery data indicate that most scaup leave the state during winter. Greater scaup occur in nearshore marine and fresh-water habitats of the Aleutian Islands (≤1,000), lower Alaska Peninsula (≤3,000), Kodiak Island (≤4,000), Gulf of Alaska (1,000's) and southeast Alaska (≤4,000) (Isleib and Kessel 1973, Conant et al. 1980, Conant and King 1981, Forsell and Gould 1981, Byrd 1992, Conant 1996, C. Dau pers. comm.).

Distribution: The greater scaup has a circumpolar distribution, with the exception of Greenland and the Canadian high arctic islands, and is a common breeder in the tundra and taiga zones of Iceland, northern Scandinavia, Russia, Alaska and the Yukon and Northwest territories of Canada south to Hudson Bay (Bellrose 1980, Palmer 1976)(Fig. 31). Most greater scaup nest in western and northern coastal Alaska and along the Beaufort Sea. Principal breeding areas in Alaska are tundra habitats of the YKD, Bristol Bay, Kotzebue Sound and Seward Peninsula along the western coast and the ACP to the north (King and Lensink 1971, Hodges et al. 1996, King and Brackney 1997) (Fig. 31).

Scaup are not identified to species during spring pair surveys. Greater scaup, however, are believed uncommon in interior, boreal forest areas. Waterfowl Production Surveys indicate about 25% of scaup broods seen in interior strata were greater scaup (Hodges and Conant 1990, Hodges 1991). Lesser scaup are rare in coastal, tundra habitats. These geographic differences allow reasonable speculation that essentially all scaup observed in tundra areas are greater scaup. The highest density of probable greater scaup recorded on the Alaska-Yukon portion of the NAWBPS is found in Kotzebue Sound (Selawik and Kobuk river valleys) with an average of 4.1 birds/km^2 (Hodges et al. 1996). Other important breeding habitats are the YKD, Bristol Bay, Seward Peninsula and the ACP (Hodges et al. 1996, King and Brackney 1997). Greater scaup densities averaged 6.0 and 10.8 birds/km^2 at two sites along the lower Alaska Peninsula (Dau and Schafer 1996) and 7.7 birds/km^2 at a mid-coastal area of the YKD (B. McCaffery pers. comm.)..

Band recovery data indicate a split migration for greater scaup banded on the YKD and Selawik NWR; with most recoveries in the mid-Atlantic coastal states and recoveries on the Pacific coast from Puget Sound south to central/northern California (Fig. 32). Scaup typically winter on coastal embayments or where open water may be found.

Conant (1996) estimated only 3,400 scaup wintered in marine waters of southeast Alaska in 1996 and although not identified to species, these are most likely greater scaup. Spring and fall numbers of greater scaup in southwest Alaska average 3,486 and 1,896, respectively with peaks of 12,762 in spring and 5,748 in fall (R. King pers. comm.). Peak numbers of greater scaup on the southern Alaska Peninsula in fall and winter were 3,097 and 2,647, respectively (C. Dau pers. comm.). Greater scaup have been reported as common throughout the Aleutian Islands (Murie 1959) with up to 500 wintering at Adak Island (Byrd et al. 1974). Up to 4,000 scaup are estimated to winter in marine habitats of the Kodiak Archipelago (Forsell and Gould 1981).

***Breeding Biology*:** Most greater and lesser scaup first nest at 2 years old (Bellrose 1980). Pairs are renewed each winter and broken early in the incubation period (Palmer 1976). Lesser scaup are highly pholopatric to natal and breeding areas, and likely this is true of greater scaup (Austin et al. 1999). On the YKD, greater scaup nest on marshy, lowland tundra extremely close to the water. Clutch size is usually 7-10 eggs; incubation for greater and lesser scaup ranges from 23-28 days (Bellrose 1980, Vermeer 1979). Scaup nest late relative to other species of waterfowl. Greater scaup arrive at nesting areas from mid-May through early June. On the YKD, peak nest initiation occurs about mid-June. Scaup will commonly renest. At Selawik NWR, hatching occurred from 16 July to 8 August, with the peak 21-22 July (Shepherd 1955). Scaup are subject to inter- and intraspecific nest parasitism. Duckling and brood survival data do not exist for scaup in Alaska.

Diet: Greater scaup are opportunistic and feed on both plants and animals. Principle foods are aquatic invertebrates (mollusks, crustaceans, insects). Amphipods, primarily *Hyalella* and *Gammarus* spp., are a primary food of migrating and breeding scaup (Ausin et al. 1999). Over 90% of the food of greater scaup taken from Humboldt Bay, California, consisted of mollusks

(Munroe 1941). On the Great Lakes, scaup have readily adapted to consumption of exotic zebra mussels *(Dreissena polymorpha)*.

Threats and Mortality Factors: The switch in winter diet to zebra mussels may have deleterious effects on scaup because mussels may concentrate contaminants more than traditional scaup foods. From 1988 through 1995, scaup numbers on the Great Lakes increased by 16% per year, reflecting a change in distribution associated with their explitation of zebra mussels (Wormington and Leach 1992 and Custer and Custer pers. comml, *in* Austin et al. 1999). Studies of wintering greater scaup from Long Island Sound measured heavy metals and organochlorines and found levels that exceeded those known to adversely affect reproduction in greater scaup and other diving ducks. Preliminary work in Alaska during 1993 supports the hypothesis that contaminants may affect reproduction in greater scaup (Barclay et al. 1997). Nine heavy metals, PCBs, endrin, and DDE were documented in greater scaup eggs from nests on the YKD, and a substantial portion of these eggs were infertile (Barclay et al. 1997). In 1998, Connecticut issued an advisory on consuming greater scaup taken from Long Island Sound, citing metals and PCBs. New York issued a similar advisory in 1993 due to elevated levels of PCBs.

Nesting scaup rarely ingested lead shot on the YKD, unlike sympatric nesting eiders and oldsquaw (Flint et al. 1997).

Afton and Anderson (in review, in Austin et al. 1999) hypothesize that prairie drought may affect scaup breeding in boreal forest by reducing availability of food during spring migation and thus acquisition of nutrient reserves for breeding. If true, the recent long term drought in in the prairie-parkland biome may have contributed to the decline in the continental population of scaup.

Average reported subsistence harvest on the YKD from 1987-97 was 3,852 greater scaup (Wentworth 1998).

<u>Barrow's and Common Goldeneyes (*Bucephala islandica* and *Bucephala clangula*)</u>
Population Status and Trends: **PROBABLY STABLE**
The NAWBPS indicates variable populations of goldeneye in both interior, boreal forest and tundra strata over the past 20 years (Hodges et al. 1996) (Fig. 33). Statewide, NAWBPS estimates of goldeneye populations are higher than estimated populations in the 1960's. Since the 1960s, populations apparently increased during the 1970s, decreased during the 1980s, and have increased during the last 10 years, 1989-98. Goldeneye numbers on the Old Crow Flats have remained relatively constant (B. Conant pers. comm.).

Few goldeneyes are observed during the ACP breeding pairs and NSE survey. Barrow's goldeneyes breeding population in the Kodiak Archipelago is stable to increasing, with a population of 2,500 birds (D. Zwiefelhofer pers. comm.).

There are no estimates of winter population trends for goldeneye statewide in Alaska. Southeast

Alaska supports an estimated 133,000 wintering goldeneyes (Conant 1996). An estimated 51,000 goldeneyes wintered in the northern portion of southeast Alaska in 1981 (Conant and King 1981). Winter surveys in Prince William Sound suggest an increasing goldeneye population (mostly Barrow's) from 1990-98 (Fig. 33).

Distribution: Barrow's and common goldeneyes breed throughout boreal forest habitats from interior and southcentral Alaska to British Columbia and western Alberta south to Wyoming with Barrow's extending farther south to Oregon and California and Common's extending across the prairies of Canada to the Maritime provinces (Palmer 1976, Bellrose 1980) (Fig. 34). Species of goldeneye are not differentiated on this survey; both occur in interior Alaska where their ranges overlap (Gabrielson and Lincoln 1959, USFWS 1964). Observations on the Yukon Flats suggest Barrow's goldeneyes are sparsely distributed and less abundant than common goldeneyes (Lensink 1965). Barrow's goldeneyes predominate in southcentral coastal areas with the proportions of the two species uncertain elsewhere in their range. Breeding common goldeneyes predominate in some interior areas (Lensink 1965) and exist in apparently equal numbers with Barrow's goldeneyes in other areas (B. Skinner pers. comm., M. Bertram pers. comm.). Both species are uncommon in tundra strata where breeding habitat is limited. Barrow's goldeneyes number approximately 2,500 breeding birds in the Kodiak Archipelago (D. Zwiefelhofer pers. comm.). Highest densities for goldeneyes in Alaska on the NAWBPS are found primarily in the interior, in boreal forest habitats of the Innoko River (0.7 birds/km^2), and the Tanana and Kuskokwim River drainages (0.6 birds/km^2), and in southcentral Alaska on the Copper River Delta (0.9 birds/km^2) and in the Kenai-Susitna area (0.5 birds/km^2)(Hodges et al. 1996). Barrow's goldeneyes are rare west of the Alaska Peninsula.

Males apparently depart breeding areas in early to mid June (Munro 1939). Non-breeding and/or failed breeding Barrow's goldeneyes are known to molt on large fresh water lakes in interior Alaska (King 1963), and both species molt on large lakes in southwest Alaska (King 1973). Barrow's goldeneyes comprised all of 3,056 molting birds captured during banding on the Yukon Flats (King 1963) while on the inland portion of the YKD, where neither goldeneye species likely breeds, 108 common goldeneyes and 6 Barrow's goldeneyes were captured in a similar effort (King 1973). Hundreds of molting goldeneyes were observed on large inland lakes of the YKD in 1998 (B. McCaffery pers. comm.). Most recoveries of Barrow's goldeneyes banded on the Yukon Flats (King 1963) and YKD (King 1973) have occurred in the Kodiak Archipelago during winter (D. Zwiefelhofer pers. comm.) (Fig. 35). Few recoveries of common goldeneye exist.

In Alaska, wintering common goldeneyes are common from the Aleutian Islands and Alaska Peninsula east through southcentral Alaska to southeast Alaska (Gabrielson and Lincoln 1959, Murie 1959, Islieb and Kessel 1973, Byrd et al.1974). Conant (1996) estimated 133,000 goldeneye wintered in southeast Alaska in 1996. A few "tens of thousands" of both species (combined) occur in coastal southcentral Alaska (Islieb and Kessel 1973). Spring and fall numbers of goldeneye in southwest Alaska average 213 and 251, respectively (R. King pers. comm.) with peaks of 813 in spring and 1,899 in fall. Peak numbers of goldeneye (probably commons) during fall and winter on the south side of the Alaska Peninsula were 720 and 2,187, respectively (C. Dau pers. comm.).

***Breeding Biology*:** Goldeneyes begin breeding when 2-3 years old. Goldeneyes nest in natural cavities, usually in trees, and nest boxes. Barrow's goldeneye have also been found nesting in holes in the ground and in crow nests in western British Columbia (Edwards 1953, Prince 1968). Swarth (1926) found young broods of Barrow's on alpine lakes in northern British Columbia where no tree cavities existed, indicating that nesting occurred on or in the ground. In British Columbia, common goldeneye often resort to pileated woodpecker and flicker cavities that were enlarged by weathering. The eggs of the two species of goldeneye are almost identical. Goldeneyes deposit their eggs at a slow rate, averaging 1.5 days per egg (Bellrose 1980). Clutch size of both goldeneyes averages about 9 eggs. Nesting success is typically high. Young fledge at 8 weeks of age. Yearling goldeneyes may be attracted to future nest sites by following breeding hens (Bellrose 1980). Pairs may remain intact for several years, reuniting on coastal and estuarine wintering areas (Savard 1985). Because of the brief span of nest initiation, it is doubtful that many hens whose nests are destroyed during incubation have sufficient time to renest.

Diet: Both species feed close to shore. Common and Barrow's goldeneye, in freshwater areas, eat a variety of aquatic insects, the most important being damselfly and dragonfly nymphs, caddis fly larvae, water boatmen and midge larvae (Cottam 1939). Salmon and herring eggs are taken when available. Mollusks, mainly blue mussels, are the primary food of Barrow's goldeneyes in marine areas during winter in Alaska and in British Columbia, and crustaceans are the staple winter diet of common goldeneye (Vermeer 1982).

Threats and Mortality Factors: Franson et al. (1995a) found elevated concentrations of cadmium and zinc in tissues of Barrow's goldeneyes in Misty Fjords National Monument from 1980-82. They also found elevated levels of cadmium in blue mussels, the primary food of Barrow's goldeneyes. Elsewhere in their range, common goldeneyes have been seriously contaminated with trace metals, pesticides and other contaminants, especially in industrial areas such as the Great Lakes.

Continued logging of old growth timber in southcentral and southeast Alaska may reduce the number of natural cavities used by goldeneyes for nesting.

Average reported subsistence harvest on the YKD from 1987-97 was 1,505 goldeneyes (Wentworth 1998) (Table 2).

Bufflehead (*Bucephala albeola*)

Population Status and Trends: **STABLE**

The NAWBPS suggests a variable but fairly stable population of bufflehead in Alaska since the late 1950s (Fig. 36). Populations increased during the 1960s and 1970s, decreased slightly during the 1980s, and show an increasing trend over the last 10 years, 1989-98.

Few bufflehead are observed during other surveys that might indicate trends. Winter surveys in

Prince William Sound suggest an increasing bufflehead population from 1990-98 (Fig. 36). There are no other estimates of winter population trends for bufflehead statewide in Alaska. Southeast Alaska supports an estimated 45,000 wintering bufflehead (Conant 1996), Prince William Sound holds about 9,000 (B. Lance, pers. comm.), and Kodiak holds >5,000 (D. Zwiefelhofer, pers. comm.).

Distribution: Bufflehead breed throughout boreal forest habitats from interior and southcentral Alaska to British Columbia east to Quebec and south to Wyoming, Oregon and California (Erskine 1972, Palmer 1976, Bellrose 1980) (Fig. 26). Bufflehead nest inland, and occur mostly on shallow salt water the rest of the year (Palmer 1976). In Alaska, highest densities of bufflehead observed on the NAWBPS are in the interior boreal forest habitats of the Tanana and Kuskokwim River drainages (0.7 birds/km^2), Nelchina Basin (0.6 birds/km^2), and the Yukon Flats (0.5 birds/km^2)(Hodges et al. 1996).

Males apparently depart breeding areas in June (Munro 1942, Erskine 1972). Non-breeding and/or failed breeding bufflehead are known to molt on large fresh water lakes in interior (King 1963) and southwest Alaska (King 1973) and elsewhere throughout their range.

Band recoveries indicate that bufflehead banded in Alaska winter exclusively along the Pacific coast, mostly from Kodiak Island to Washington (Fig. 37). In Alaska, bufflehead winter from the Aleutian Islands and Alaska Peninsula east through southcentral Alaska to southeast Alaska (Gabrielson and Lincoln 1959, Murie 1959, Islieb and Kessel 1973). Conant (1996) estimated 45,000 bufflehead wintered in southeast Alaska in 1996. Up to 5,000 bufflehead have consistently wintered in the Kodiak Archipelago over the past two decades (Forsell and Gould 1981, D. Zwiefelhofer pers. comm.). Peak numbers of bufflehead on the southern Alaska Peninsula in fall and winter were 120 and 342, respectively (C. Dau pers. comm.). Bufflehead are uncommon on spring and fall surveys in southwest Alaska with averages of 12 and 19, respectively (R. King pers. comm.) and peaks of 92 in spring and 65 in fall.

***Breeding Biology*:** Bufflehead are not known to breed until they are nearly two years old. Most pairs are formed during winter or spring migration. Bufflehead nest in small cavities in trees located near a river, pond or lake. Most nests are 2-10 feet above ground. Bufflehead usually return in subsequent years to the same nest area (Erskine 1961, Gauthier 1990). Bufflehead lay eggs at the rate of about one every 1.5 days. Clutch sizes average about 9 eggs and incubation period is 29-31 days. On the northern fringes of their breeding range, nesting starts about mid-May and peaks about May 20. The span of initiation in the northern regions of their breeding range is brief, 15 to 25 days. Nest success is typically high. There is no evidence of renesting for bufflehead. Young fledge at 50-55 days. Erskine (1972) observed that males severed ties with their mates shortly after hens began to incubate. Successful breeders likely rear their young and molt on large lakes near their nesting areas (Erskine 1972).

Diet: Buffleheads feed primarily on aquatic invertebrates (dragonfly, damselfly and mayfly nymphs, caddis fly and midge larvae, and water boatmen) during the breeding season (Erskine 1972). They will also take seeds of pondweeds and bulrushes. On freshwater areas during winter, snails constitute about 19% of all food items consumed. In marine areas, animal foods, consisting mostly of crustaceans (isopods, amphipods and shrimp) and mollusks, comprised 84% of the diet in spring and 90% during the fall and winter (Bellrose 1980). Vermeer (1982) found that main foods of bufflehead during winter in coastal British Columbia were shrimp, snails, and isopods.

Threats and Mortality Factors: Average reported subsistence harvest on the YKD from 1987-97 was 291 bufflehead (Wentworth 1998).

Common and Red-breasted Mergansers (*Mergus merganser* and *Mergus serrator*)
Population Status and Trends: **PROBABLY INCREASING**
NAWBPS data indicate a variable but increasing merganser population (J. Hodges pers. comm.)(Fig. 38). Red-breasted mergansers are more abundant in the surveyed area and probably make up most observations, comprising essentially all observations in coastal tundra areas. In all Alaskan areas surveyed, too few mergansers are observed and variability is too high to allow confident conclusions regarding their status.

There are no estimates of winter population trends for mergansers statewide in Alaska. Winter surveys in Prince William Sound suggest an increasing population from 1990-98 (B. Lance, pers comm.)(Fig. 38). Southeast Alaska supports an estimated 90,000 wintering mergansers (Conant 1996). At least 3,500 common merganser and 5,500 red-breasted merganser winter in the Kodiak Archipelago (D. Zwiefelhofer pers. comm.).

Distribution: Common and red-breasted mergansers have a holarctic distribution. Both species breed across northern Canada to the Maritime provinces with red-breasted mergansers extending farther north to the arctic and common mergansers ranging farther to the south through the Rocky Mountain states to New Mexico and the Pacific states to central California (Fig. 39). Red-breasted mergansers breed throughout Alaska and are most numerous in coastal tundra habitats, whereas common mergansers breed more in boreal forest habitats of the eastern interior of Alaska and Kodiak Island, southcentral and southeast Alaska (Palmer 1976, Bellrose 1980). Species of merganser are difficult to differentiate during aerial surveys and therefore are grouped on the NAWBPS. The highest densities for mergansers in Alaska observed on the NAWBPS were in southcentral areas including the Copper River delta (0.4 birds/km^2) and Kenai-Susitna (0.1 birds/km^2), and in tundra areas of Bristol Bay (0.1 birds/km^2) and the Seward Peninsula (0.1 birds/km^2)(J. Hodges pers. comm.).

The migration and other movements of mergansers in Alaska are poorly understood. Most males apparently abandon their mates early in incubation, about mid-June, and move to coastal areas or large lakes to molt (Palmer 1976).

Wintering common mergansers are found primarily from the Alaska Peninsula east through southcentral Alaska to southeast Alaska (Gabrielson and Lincoln 1959, Murie 1959, Islieb and Kessel 1973). Small numbers of common mergansers winter in the Aleutian Islands (Murie 1959, Byrd et al. 1974). A minimum of 3,500 common mergansers and 5,500 red-breasted mergansers winter in the Kodiak Archipelago and populations may have increased over the past two decades Forsell and Gould 1981, D. Zwiefelhofer pers. comm.). Both species are common winter residents in coastal southcentral Alaska (Islieb and Kessel 1973). Conant (1996) estimated 90,000 mergansers wintered in southeast Alaska in 1996. Spring and fall numbers of mergansers in southwest Alaska, predominately red-breasted mergansers, average 1,295 and 251, respectively (R. King pers. comm.) with peaks of 3,749 in spring and 1,771 in fall. Peak numbers of red-breasted mergansers on the southern Alaska Peninsula in fall and winter were 935 and 2,640, respectively, while common mergansers were only seen in winter with a maximum count of 568 birds (C. Dau pers. comm.). Red-breasted mergansers traditionally congregate during spring migration at certain areas of coastal southwest Alaska (Fig. 40)(Larned 1998).

***Breeding Biology*:** Mergansers are not known to breed before their second year. Red-breasted mergansers arrive on nesting grounds in pairs and frequently occupy the same nest sites several years in succession. Males desert their mates early in the incubation period. Unlike common mergansers which usually nest in tree cavities, red-breasted mergansers nest on the ground in a variety of sites. However, where suitable tree cavities are lacking, common mergansers also resort to nesting on the ground. They have been found nesting in marshes, on rocky islets, on vegetated islands on large lakes in bank recesses and under piles of driftwood. At Hooper Bay, Alaska, Brandt (1943) found red-breasted mergansers nesting near tundra ponds screened by long grass. Nest sites are usually close to water, but may be hundred of meters from water. Clutch size averages 9 eggs. Dates of nest initiation in Alaska range from 30 May to 20 July (Gabrielson and Lincoln 1959). Red-breasted mergansers are subject to inter- and intraspecific nest parasitism. Red-breasted mergansers nest considerably later than common mergansers and their young often do not fledge until September. They often form large creches in coastal areas with high densities of breeders.

Diet: Red-breasted mergansers and common mergansers are fish eaters and will concentrate in large groups near shore to feed on schools of herring.

Threats and Mortality Factors: Oil spills and disturbance pose risks to wintering flocks in coastal areas.

Average reported subsistence harvest on the YKD from 1987-97 was 93 common mergansers and 273 red-breasted mergansers (Wentworth 1998). Sport harvest statewide is minimal.

HARVEST

Sea Duck Stocks Subject to Harvest:

In Alaska, sea duck harvests are derived from breeding stocks, migrants, and wintering aggregations. For example, traditional early spring subsistence hunting is directed at northward migrations of eiders, scoters and long-tailed ducks. These birds also are taken for subsistence on their breeding grounds in Alaska, Canada, and Russia. As these birds move north and disperse, harvest is focused more on local breeding populations.

Males and immature sea ducks provide additional harvest on their early summer flights to molting grounds. Sea ducks often molt in large numbers at traditional areas, and molt migrations exhibit substantial seasonal exchanges of sea ducks between Alaska, the Russian Far East, and Arctic Canada. Historically, scoters and other sea ducks have been harvested efficiently for subsistence on molting areas during mid-summer. During pre-migration gatherings and fall migration, females and young from breeding areas merge with molters and aggregate on staging areas. Fall harvest affects mixtures of stocks from many areas.

On winter terminus areas in coastal waters, sea ducks are used by different groups of hunters. In some regions where migrating dabbling ducks are present only briefly, sea ducks provide the majority of waterfowl hunting opportunity and are harvested through January. Alaska's wintering sea ducks comprise a mixture of birds from breeding areas as distant as the Russian Far East and Arctic Canada.

Sources of Harvest Data:

Information on sea duck harvest in Alaska is derived from two separate but complementary sources: standardized mail surveys of licensed hunters, and community-based surveys of rural households that participate in subsistence hunting. Both the USFWS (USFWS) and Alaska Department of Fish and Game (ADFG) have conducted standardized mail questionnaire surveys of licensed hunters since the early 1970s. Since the 1980s, ADFG and USFWS also have worked with Alaska Native organizations and local hunters to document rural subsistence harvests of wild resources throughout the state (Wolfe and Walker 1987).

Distribution of mail questionnaires and hunter response rates to these surveys have been poor in rural areas, so these surveys best characterize harvest by hunters from urban areas and the road system during the regulated fall/winter season. Village household surveys provide a better means to gather data in multicultural rural areas and to document migratory bird harvest that, in some regions, largely occurs outside the legal hunting season. Although the results of the two survey approaches are generally segregated geographically, their methods are quite different and survey sampling is not mutually exclusive. Consequently, estimates of harvest from the 2 types of surveys should not be treated additively.

Fall/Winter Harvest Measured by Mail Surveys ("Sport" Harvest)

State and Federal Mail Surveys:

From the 1970s through 1997, harvest of sea ducks in Alaska has been estimated annually through voluntary surveys of licensed hunters by both the ADFG and the USFWS Office of Migratory Bird Management in Laurel, MD. The federal survey of hunters was based on distribution of contact cards through a sample of post offices, mailing questionnaires to selected hunters, and development of harvest estimates from the number of federal duck stamps sold and reported harvest (see Voelzer et al. 1982). ADFG initiated a state waterfowl harvest survey in 1971 to improve the accuracy of statewide and regional estimates of harvest over results of the federal survey (Timm 1972, Campbell 1984). ADFG conducted surveys in 1971-76, 1982-85, 1987-90 and 1992-97. Through 1985, the state survey drew on a sample of all hunting license buyers who were sent post-season harvest report cards, but this was inefficient at accessing the 10-15% of hunters that hunted waterfowl. In 1987, the state survey was redesigned and linked to the sale of state duck stamps, and 40% of buyers were given an in-season harvest survey card (Campbell and Rothe 1989).

Although both surveys sampled licensed hunters throughout the state, the federal mail survey has had notably incomplete distribution of contact cards in many areas. The state survey obtained consistently higher response rates than the federal survey, providing better estimates of statewide and regional harvests. However, coverage and response to both surveys has been inadequate to obtain the desired level of reliability in annual estimates and trends of harvest over short-term periods.

As a result of inadequate harvest surveys across the country, state wildlife agencies and the Service developed the national Migratory Bird Harvest Information Program (HIP), implemented in all states by 1998. HIP requires enrollment and identification of all migratory bird hunters to enhance sampling capability, it uses screening questions during enrollment about hunter harvest in the previous year to allow stratified sampling by species hunted and hunter success, and harvest estimates are developed from post-season questionnaires. For the first time, in 1998, harvest surveys may now be directed at subsets of hunters that reported harvesting certain groups of migratory birds, such as sea ducks. This should greatly improve information on the distribution of sea duck hunters, whether sea ducks were taken incidentally or during special hunts, and estimates of harvest for sea duck species.

Parts Collection Survey:
Neither the federal nor state mail surveys measured species composition of the duck harvest directly from hunter-reported data. The state harvest survey had a separate response category called "sea ducks" to capture harvest data on species included by regulation in separate sea duck bag limits (eiders, scoters, long-tailed duck, harlequin, and mergansers; not goldeneyes and buffleheads). However, species harvest estimates for waterfowl in both state and federal surveys rely on a separate process. The Service conducts a national Parts Collection Survey to determine species composition of duck harvest from wings submitted by a sample of hunters (Carney 1982). These data have better utility across broad geographic areas (e.g. flyway level, some states), but small sample sizes have been inadequate for use at regional levels and for annual and short-term use. Since 1966, sea duck harvest composition by species (15 species), sex and age has been estimated annually for the entire state from an average of 112 sea duck wings (range: 35 to 314).

History of Sea Duck Hunting Regulations in Alaska:
Beginning in the 1948-49 season, waterfowl hunting regulations were formulated by flyways and Alaska's seasons and limits were the same as other Pacific Flyway states. However, since 1950, Alaska has been the only state outside of the coastal Atlantic Flyway states to be allowed a special sea duck season and/or separate sea duck bag limit. In 1950, Alaska was given an extended season only on scoters and eiders, with extensions differing among zones from 6 to 51

additional days. The sea duck limit was 10 per day, in addition to the basic limit of 6 ducks and special limit of 25 common and red-breasted mergansers during the regular season (Bartonek 1993).

In 1954, sea duck limits were expanded to include long-tailed ducks (oldsquaw), harlequin ducks, and both common and red-breasted mergansers, although the 25-bird limit on mergansers was not incorporated within the sea duck limit until 1957. In 1961, the general waterfowl season was extended to the maximum allowed by treaty, 107 days, eliminating the distinction of the special sea duck season. The aggregate limit of sea ducks, including mergansers, was increased from 10 to 15 ducks per day (Bartonek 1993).

In recent years, a variety of concerns about sea duck populations has led to hunting restrictions. After the *Exxon Valdez* oil spill, the Alaska Board of Game delayed the opening of harlequin duck hunting to October 1 and reduced limits to 2 daily, 4 in possession, in Prince William Sound. Concern for populations of Steller's and spectacled eiders, while under consideration for listing under the Endangered Species Act, prompted a closure of hunting for these two species in 1991. Broad concern about sea duck populations in general has led to proposed restrictions in Alaska sea duck bag limits for the 1999-00 season, adopted by the Board of Game and endorsed by the Pacific Flyway Council. These proposals are currently under consideration by the Service.

***Hunter Participation**:*
The nature of state and federal mail surveys and small numbers of responses has made it difficult to estimate the number of waterfowl hunters that hunt sea ducks. A cursory examination of responses to the state surveys in the late 1980s suggested that about 1,000 to 1,500 hunters had harvested sea ducks out of approximately 10,000 total active waterfowl hunters. The highest percentages of hunters that reported taking sea ducks were from Cook Inlet and Kodiak, each with 25-30%, followed by southeast Alaska with about 20%. The survey responses do not provide information on the number of hunters taking sea ducks incidental to hunting of other waterfowl or those that directed hunts at sea ducks.

***Size of Fall/Winter Sea Duck Harvest**:*
The annual number of mail questionnaire survey respondents reporting a sea duck harvest was very low. Because the state survey has consistently received a greater response rate from sea duck hunters than federal surveys, particularly in populated areas of southern Alaska where sea ducks are hunted in fall and winter, state data are presented here.

Although annual estimates of Alaska sea duck harvest are imprecise, harvest levels seem to have been relatively stable over the long term and generally related to the total number of active waterfowl hunters afield (Fig. 41). Since 1971, the average harvest has been about 6,300 sea ducks (n=14), with annual estimates ranging from 5,300 to 9,000. Period averages provide some insight into trends in harvest over the past 27 years (Table 3). During the early 1970s, sea duck harvest averaged 5,300 and the number of waterfowl hunters in Alaska was fairly stable. From the mid-1970s through the mid-1980s, economic growth associated with oil development produced an increase in population and waterfowl hunters. The average number of sea ducks harvested increased accordingly (Table 3).

In 1985, harvest restrictions were imposed on duck hunting nationwide and continued through 1994. In Alaska, basic duck bag limits were reduced by 2 birds daily and special restrictions were applied for pintails. Similar to a trend across the country, the number of active duck hunters declined in Alaska, and sea duck harvest declined moderately (Fig. 41). Duck bag limits were restored for the 1995 season and the number of active waterfowl hunters and sea duck harvest has gradually increased.

Although historical harvest surveys do not provide information on the degree to which hunters direct their hunting toward sea ducks, the number of sea ducks harvested per active hunter (all waterfowl hunters) was stable through the 1980s and has increased in the 1990s (Fig. 42). This may be related to changes in hunter behavior. There is some evidence that, during the period of nationwide duck regulation restrictions, the more dedicated hunters remained active while casual duck hunters did not participate. Thus, duck harvest per hunter did not decline concurrent with declines in numbers of hunters (Fig. 41 and 42). In addition, hunters may have redirected their activities from dabbling ducks to geese and other species, perhaps sea ducks. Both new patterns of hunting sea ducks and an increase in active hunters may explain higher harvests of sea ducks in the past few years (Fig. 41).

Species Composition in the Harvest:
Over the long term, since 1966, sea ducks have comprised an average of about 3.6% of the total duck harvest in Alaska, as measured by standard surveys (Table 4). Although annual species composition data are highly variable, scoters (mostly surf and white-winged) make up over 55% of the measured fall/winter sea duck harvest (Table 4; Fig. 43). Wintering scoters are abundant and form a substantial portion of sea duck harvests in Kodiak, lower Cook Inlet, and Southeast Alaska. Harlequin ducks that occur on all coastal wintering areas and are more accessible to most shore-based hunters make up 17% of the fall/winter sea duck harvest. Long-tailed ducks are also found on most coastal wintering areas, but their distribution is patchy and they inhabit deeper and more exposed waters that are more difficult to hunt; they comprise about 12% of the fall/winter sea duck harvest.

Geographic Distribution of Harvest:
Mail questionnaire data have not provided reliable information on regional harvests across the state because of uneven sampling and response rates (Table 3). At regional levels, estimates are based on very small numbers of responses from sea duck hunters, and data from the federal Parts Collection Survey (statewide) should not be applied to regional harvest data to estimate species composition. Therefore, caution is warranted in using these data for regional management decisions. The regions of Cook Inlet, Kodiak, and Southeast Alaska have produced most of the responses to mail surveys (Table 3) and have the highest proportion of the state's fall/winter sea duck hunters (combined 63-75% of total). Mail survey data indicate that sea duck harvest was

highest in Kodiak and lower Cook Inlet, followed by Southeast (Table 3; Fig. 44).

Subsistence Harvest

In Alaska, “subsistence” is defined in federal and state laws as “customary and traditional uses” of wild renewable resources for food, materials, sharing, barter, customary trade, and crafts. In practice, subsistence waterfowl hunting is part of an annual round of diverse harvesting activities, focused on seasons of best availability. Patterns of seasonal use of sea ducks and species composition in the harvest differ widely across Alaska.

Methods:

Since the late 1970s, ADFG’s Subsistence Division has been documenting subsistence harvests of wildlife throughout the state. In addition, the Service has conducted harvest surveys in rural communities in and near National Wildlife Refuges. Over the past 10 years, both agencies have cooperated with Alaska Native organizations to improve rural survey coverage and estimates of migratory bird harvests in Alaska. Most of these surveys involve community-based sampling of households and interviews with key respondents. This method, although more intensive and difficult to conduct over broad regions, is considered more reliable in obtaining harvest data in rural areas. Village harvest surveys can be designed in the most culturally appropriate manner and utilize trained local surveyors that can more effectively elicit harvest information. This approach is particularly useful in gathering information about subsistence hunting of waterfowl, much of which occurs outside legal seasons.

Wolfe et al. (1990) first summarized migratory bird subsistence harvest information for the entire state by compiling community survey data from all sources. Survey coverage of rural communities differed widely among regions and extended over a period of 10 years. To synthesize this information, regional harvest estimates were developed by extrapolating data from surveyed communities to others with similar harvest patterns. In addition, the data were standardized to 1985 community population levels. As a consequence, the subsistence harvest estimates that were developed represent a *characterization* of migratory bird harvest in the mid-1980s, rather than precise estimates. An update to that report (Paige and Wolfe 1997) compiled information from additional communities surveyed through 1995, included further analysis on seasonality of harvest, and produced revised estimates of migratory bird harvest levels. A second update, in preparation, adds the most recent surveys and contains a more detailed analysis of species composition in subsistence bird harvests (Paige and Wolfe 1999).

Subsistence waterfowl harvest surveys have been conducted on the YKD since 1987 by the USFWS with support from the Association of Village Council Presidents’ Waterfowl Conservation Committee. The survey form contains pictures of the 40 species of birds included in the survey and spaces to mark down the numbers of birds and eggs taken. There is one page for each of five survey periods (spring, early summer, mid-summer, late summer, and fall). In each village that participates in the survey, a local Yup’ik speaking resident is contracted to distribute and collect the survey forms. The survey covers a 38-village area divided into 6 strata on the basis of ecology and geography. Since 1985, 45-75% of the YKD villages have taken part in the survey, and participation has increased in recent years. Each year results of the survey sample are expanded to estimate the harvest from all households in each sampled village, then expanded again to estimate harvest from each region of the YKD. Table 2 summarizes 11 years of subsistence harvest survey data for sea ducks on the Yukon-Kuskokwim Delta (Wentworth 1998).

Size of Sea Duck Subsistence Harvest:
A conservative estimate of about 12,000 hunters harvested migratory birds in rural Alaska annually during mid-to-late 1980s (Wolfe et al. 1990), and there were an estimated 11,686 hunting households in rural Alaska in 1995 (Paige and Wolfe 1997). Based on harvest survey information primarily collected by the ADFG and the USFWS, the total estimated annual subsistence harvest of ducks in Alaska during the mid-to-late 1980's was 259,000 ducks, including 49,300 sea ducks and mergansers (Wolfe et al. 1990). Statewide harvest estimates, updated for 1996, included 57,500 sea ducks (Table 5; Paige and Wolfe 1999).

Waterfowl eggs are also harvested in the spring, but numbers and species differ widely by region. An estimated annual harvest of 83,603 eggs during the 1980s was composed of mostly eggs of gull species (68.6%), but included an estimated 11,000 duck eggs (Wolf et al. 1990). Species composition of the duck egg harvest is unknown.

In the mid-1980s, rural subsistence harvest of migratory birds was five times larger than migratory bird harvest by hunters from Alaska urban areas (Wolfe et al. 1990). Currently, rural sea duck harvest is about nine times greater than that of urban hunters.

Regional and Seasonal Distribution of Harvest:
According to Paige and Wolfe (1999), the top ranked regions, in terms of per capita bird harvests, were the Inupiat communities of St. Lawrence/Diomede Islands (22.3 birds per person); Athabaskan communities of the Yukon-Koyukuk-Lower Tanana (8.2 birds per person); and the Yup'ik communities of Bristol Bay (5.5 birds per person) and the Yukon-Kuskokwim Delta (5.4 birds per person).

Traditional hunting periods are timed in accordance with the availability of birds, rather than the dates of local open seasons. Statewide, 51.4% of subsistence harvest of migratory birds occured during spring, 4.4% during mid-summer, and 44.3% from late summer through winter during the 1980s (Wolfe et al. 1990). Recent data through 1995 suggest a similar distribution with a 4% increase in the mid-summer and a corresponding decrease in the late summer-fall-winter period (Paige and Wolfe 1997).

Regional differences in subsistence harvest of waterfowl are largely a product of seasonal distribution and availability of species. Subsistence harvests of sea ducks and other waterfowl are highest in the west and north during spring-summer and during fall-winter in the south and southeast (Table 5; Fig. 45). Coastal waters and tundra areas of the YKD and Arctic Slope support the largest numbers of sea ducks during spring migration and summer breeding seasons, and provide the most hunting opportunity (Fig. 46). Sea duck harvests are conducted mostly in spring when birds are concentrated and moving north. In the YKD region, eiders and scoters are abundantly available during spring migration, and many sea ducks breed in the region, thereby resulting in the largest regional harvest of sea ducks in the state (Table 5). Sea duck harvest is substantial also on the Arctic Slope, but it is predominately made up of eiders that are harvested during the early summer molt migration of males and August migration of females and juveniles (Fig. 45). An important sea duck harvest in Interior Alaska is composed primarily of surf and white-winged scoters that move inland to breed.

In contrast, communities of the Aleutian and Pribilof Islands, Alaska Peninsula, Gulf of Alaska coast, Kodiak, and southeast Alaska harvest sea ducks mostly during fall migration and on their wintering areas (Fig. 45). Most sea duck species aggregate in these southern coastal waters by November and are locally available to hunters through early March. Scoters are particularly preferred by winter hunters, but harvest composition is diverse; long-tailed ducks and harlequin ducks are also widely available.

Species Composition:

The species composition of Alaska's subsistence waterfowl harvest could not be estimated reliably from historical survey data (Wolfe et al. 1990). Survey methods employed widely varied levels of detail on the kinds of birds that were harvested, and species-level information is still incomplete for many areas. The most commonly reported "species" included mallard and pintail, followed by teal, eider, wigeon, long-tailed duck, goldeneye, scaup, merganser, shoveler, gadwall, bufflehead, and harlequin. A more detailed analysis of species composition in subsistence harvests is currently in progress (Paige and Wolfe 1999). There is considerable variation in species composition of sea duck harvests between regions (Table 5), but it is clear that eiders and scoters make up a large majority of the total, along with widely distributed long-tailed ducks (Fig. 47).

Harvest Regulation:

The U.S.-Canada 1916 Convention for the Protection of Migratory Birds and the 1936 Convention between the U.S. and Mexico prohibited all hunting of migratory birds between 10 March and 1 September with some limited exceptions. This provision conflicts with centuries-old practices of native peoples of the north. Because of the long-established dependence on spring hunting of migratory birds in rural Alaska, the closed season has not been strictly enforced, provided that birds were taken in a non-wasteful manner and used for food. In 1995, the U.S. and Canada and in 1997 the U.S. and Mexico, signed protocol amendments to allow for regulated hunting of migratory birds outside the previous framework in Alaska and northern Canada.

The Protocols were ratified by the U.S. Senate in October 1997. Establishment of a process to develop regulations, policies and management programs for spring and summer subsistence hunting in Alaska has begun. This process will involve one or more co-management bodies made up of federal, state and Alaska Native representatives; consultations with other states through flyway councils, and completion of federal and state regulatory procedures. The new system, particularly the management bodies, will play a vital role in evaluating the status of sea ducks, developing better harvest information, and creating effective harvest strategies to address problems.

DISCUSSION AND CONCLUSIONS

Information on the ecology and life history of sea ducks is lacking. Specifically, data on demography, productivity, annual recruitment, age-related survival, food habits, location of molting areas, mortality factors, and human harvest are inadequate. Despite the paucity of ecological data for sea ducks, there are indications of population declines in several species based on data from aerial surveys. Although trend data may be sufficient to document population problems, precise historic numbers and rates of decline are frequently unknown.

Species of particular conceern are spectacled eider, Steller's eider, and oldsquaw, whose population declines are most obvious. Data for most of the other sea duck species are insufficient to reach definitive conclusions about population status, however, several species including king and common eiders, all 3 species of scoters, harlequin duck, and scaup deserve special attention.

The only long-term annual data for sea duck abundance are those from the NAWBPS. These data are invaluable, but have limitations as discussed earlier, and some caution must be exercised when interpreting trends based on data from this survey. First, as mentioned earlier, these surveys were not designed to survey sea ducks. Second, the year of reference for any analysis of trends is important. Because of a change in aircraft that improved detection rates, trend lines were fit for 2 periods: 1957-76 and 1977-98. The break was justified based on comparisons of observers before and after the aircraft switch (Hodges et al. 1996). The break also occurred when several sea duck species (oldsquaw, black scoters, scaups, bufflehead, and goldeneyes) were at all-time high levels. Consequently, using 1977 as the point of reference, these populations have apparently declined. However, declines for these species are less pronounced or nonexistent over the long term (1960's to present), and with few exceptions, sea duck populations seem to have stabilized over the past 10 years, 1989-98. Is it possible that some sea duck populations, for whatever reasons, undergo natural cyclic fluctuations? Were environmental conditions favorable/optimal for sea ducks in general during the 1970's?

Interpretation of these trend data could improve with better information on temporal and spatial distribution, and population size and trends of individual stocks of sea ducks. There is a need to examine environmental factors that might influence survey numbers (e.g., how has the consistently earlier nesting chronology on YKD over the last 12 years affected survey results?).

Threats to sea duck populations are poorly understood. Lead poisoning, oil spills, and chemical contaminants are adversely affecting some sea duck populations. Other significant threats include oil development in the Beaufort Sea and ACP, commercial or recreational hunting/fishing, hydroelectric dams, and logging. The effects of sport and subsistence harvest, and land use factors such as harbor development, onshore seafood processing, logging, etc. on coastal habitats important to sea ducks, are not understood.

To date, sea ducks have been a lower management priority than other waterfowl and funding has been insufficient to adequately answer questions about sea duck populations needed to make appropriate management actions. The need for increased emphasis on sea duck research and monitoring seems warranted given impending negotiations of harvest regulations as a result of amendments to the Migratory Bird Treaty Act, which require sound biological data for management. Complicating these efforts is the lack of international cooperation or specific agreements for their management of species and populations of sea ducks with international breeding distributions or cosmopolitan molting and wintering areas.

Petersen and Hogan (1996) recommended a joint U.S./Canada Sea Duck Joint Venture with a goal to "identify needs, set priorities, and improve coordinated research and monitoring of sea duck populations in North America to enhance management of these populations. This includes developing a better understanding of population distributions and trends, harvest rates, production, survival rates, and habitat interactions". This draft document is a first step toward a comprehensive review of the status of sea duck populations in the Pacific Flyway, and complements efforts toward development of a sea duck management plan.

RECOMMENDATIONS OF THE SEA DUCK WORKING GROUP

The USFWS, Division of Migratory Bird Management (MBM), hosted a workshop on spectacled and Steller's eiders in February, 1991 and another workshop on other sea ducks in March, 1992 to present existing information, identify populations that might be experiencing problems, identify information needs, and develop priorities for future management and research. As a result of these workshops, additional efforts were made to provide better population information for spectacled eiders on the breeding grounds of northern and western Alaska. Shortly thereafter, additional funds were requested and approved to establish an additional pilot/biologist position within Region 7 MBM with the emphasis on sea ducks, and in particular, eider surveys. The listing of the spectacled eider as threatened under the Endangered Species Act and subsequent development of a recovery plan helped to focus a balanced management and research effort on this species. The resulting effort has dramatically increased the information available to managers and this species has risen from the least known to among the best known of the sea ducks.

Additional efforts to improve the understanding of population status and trends of other sea duck species have proceeded opportunistically in the face of little or no additional specific funding. In an effort to direct limited resources most effectively and take advantage of knowledge gained since 1992, another workshop was convened by MBM in October 1998. The working group was composed of managers and researchers representing USGS Biological Resources Division, USFWS-MBM and several national wildlife refuges, and the ADFG. Participants in this meeting attempted to build on the general recommendations from the 1991 workshop by identifying and prioritizing species-specific tasks. Participants voted for the 20 tasks that each felt were the highest priority from the list of over 70 tasks identified. The resulting list of prioritized tasks

(Appendix I) will be a useful guide to managers and researchers in Alaska as they plan sea duck activities for the short term. This effort also suggests the need for more focussed workshops on oldsquaw, scoters, and king and common eiders in the near future.

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